GARMENT INTEGRATED MULTI-CHAMBERED PERSONAL FLOTATION DEVICE OR LIFE JACKET

This application is a continuation-in-part of U.S. Serial No. 09/827,831, filed April 6, 2001, which is a continuation-in-part of U.S. Serial No. 09/641,932, filed August 18, 2000, which is a continuation-in-part of U.S. Serial No. 09/618,333, filed July 18, 2000.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to life jackets and other personal flotation devices ("PFDs"), and in particular to the prevention of airway submersion as a novel addition to the classic approach which is to recover the victim after they fall forward onto their face submerging their airway. Concurrently the instant invention continues to improve traditional face down corrective turning action. Central to the prevention of airway submersion is the separation of the centers of ballast and buoyancy. This not only creates increased torque around the axis of rotation that parallels the spine, but because of the anterior posterior separation creates a new axis of rotation around an axis that passes side to side through the thorax. Further improvements in controlling movement of the head, side to side, reduces the amount of torque required for reliable corrective turning action. This results in either decreased bulk of the buoyant moment or the amount of fluid or solid ballast needed to achieve improved airway protection for either inflatable or inherently buoyant personal flotation devices. With increasing concern about passive aspiration leading to drowning while face up in a mounting sea state

the current embodiment includes oral nasal airway protection. Due to the morbidity and mortality of rapid onset hypothermia immediate removal from cold water requires inclusion of a personal raft within the PFD that incorporates rapid inflation, and stability in choppy seas and means to survive until rescued. The present invention also provides a garment integrated multi-chambered personal flotation device, life jacket, and the like.

2. Description of the Prior Art

Extensive pool and wave tank testing of fielded and prototype personal flotation devices ("PFDs") on divergent body types indicates the clear need for continued improvement in airway protective performance. None of the jackets tested at several joint international efforts reviewing testing methodologies provided 5-second recovery of the test subjects.

Corrective turning as assessed by every government agency has been restricted to the tester assuming a horizontal face down position taking three strokes, then the administrator assess whether the individual is rolled into a face up position within 5 seconds. Past PFD designs relied upon the common understanding and practice of placing the PFD's buoyancy high on the chest. All current PFDs tested by the author fail to provide airway protection. There have been PFD recalls and refusal to grant reciprocal approval to product already in the field based on current concerns of the inadequacy of test methodologies. Some agencies instruct their test subjects to place the arms at the sides, legs together and stretch out the back as a simulation of unconsciousness. This methodology was introduced to allow comfortable recreational life jackets to be approved. *The*

use of this methodology for approval of commercial open ocean life jackets has precipitated the global current crisis, with agencies from one country recalling product from another country. The United States Coast Guard ("USCG") is currently increasing the rigor of testing by the inclusion of new tests more accurately assessing the capacity to commercial jackets to roll an unconscious victim from any position into an airway protected position within 5 seconds as mandated by the Code of Federal Regulations. The current challenge to improve the accuracy of testing is seriously compounded by a lack of PFDs capable of withstanding close scrutiny.

Recent joint Canadian and US wave tank testing of a international selection of "safety of life at sea" ("SOLAS") class PFDs disclosed that the ability of any life jacket to provide surface airway protection is constrained by the same laws of physics. Even if one is turned face up in mounting seas at very low wave height and frequency the face is awash in waves. As the seas mount, the ballast of the body is driven down in the trough of the wave and the head completely submerged. The buoyant means about the neck if secure extracts the victim in a cyclic plunging action. Thus safety and survival at sea is dependant upon being able to immediately remove oneself from the sea as quickly as possible to avoid hypothermic induced unconsciousness and cumulative aspiration secondary to splashing waves or total submersion that occurs in even relatively mild seas.

The vast majority if not all current jackets fail to turn an unconscious victim who enters the water face first, but since face first water entry is not part of any PFD evaluation program this finding remains unknown therefore unaddressed. Current life jackets also possess a Danger

Zone, defined as the vertical position in the water from which if the wearer passes out they then fall face forward into an airway submerged moment of stability. Until now the sole management of the Danger Zone was avoidance. The average user of PFDs is ignorant of the consequence of floating in the danger zone. In fact contrary to the lethal consequences of floating upright in the water column it feels intuitive to the uniformed. The vertical position is the ideal position from which to scan or signal rescue efforts. When you float upright it is easier to monitor the horizon behind you as well as that portion in front of you.

The body has highly developed postural muscles that in coordination with the vestibular apparatus of the inner ear maintain our vertical position in space. Prior jackets relied upon well-established principles that the buoyant moment belonged high on the chest in order to optimize airway protective turning. The prior art has relied strictly upon the use of buoyant means to generate the torque needed for turning and like a sail boat that had lost it's lead keel the purely buoyant PFD suffered from a lack of orientation, that is there are points of stability that are facedown as well as face up. Hence the urgent need to identify and remedy the Danger Zone.

The prior art is restricted to very severe limits on the angle of flotation of the body off of vertical as one means to avoid entering the Danger Zone. That is if a jacket floats the wearer closer than 20 to 30 degrees off of vertical it would not pass testing and would not be approved for use. At issue is that prior Life Jackets allow the center of gravity of the jacket to be balanced above the center of buoyancy by the conscious wearer floating upright in the water column as they want to be when eagerly trying

to spot search and rescue efforts. The intuitive element is that if a PFD allows the center of gravity to be located directly above the centroid of buoyancy the system is in balance and so requires very little muscular movement to maintain this position in gravity. However, the problem occurs as the water environment quickly wicks away the body's heat leading to hypothermia, obtundation and eventually loss of consciousness. Upon loss of consciousness the victim can no longer maintain their vertical position in space, they can not even hold their head erect. The debility is so complete they cannot remove their face from the water.

Reviewing the mechanics of the Danger Zone, while conscious the victim can effortlessly balance themselves upright but when the head drops forward the center of gravity suddenly also shifts forward, and the individual slumps face down.

The entire global PFD community currently accepts the SOLAS standard for turning. A SOLAS Approved Life Jacket will roll an unconscious victim from any position into and airway protected position within 5 seconds. However that same community relies some variation of the Three-Stroke Test to confirm performance to that standard. PFD design has come to rely upon the assistance provided by the tester to the serious detriment of performance. One current test methodology simulates unconsciousness by instructing the tester to take three strokes, pull the arms to the sides, place the legs together, straighten the back then drop the head. This very complex maneuver aligns the body along the axis of rotation reducing the amount of torque the Life Jacket needs to generate in order to roll the victim over. The majority of the torque is generated from the water displaced by the buoyant moment. While the Three-Stroke test

arose to facilitate the creation of comfortable recreational PFDs that same test replaced more passive simulations of unconsciousness. Clearly that more passive tester requires a Life Jacket of greater torque to perform corrective turning.

Both the commercial and recreational market place is currently full of Life Jackets that rely upon tester participation to compensate for insufficient torque. While these comfortable jackets take up less space aboard vessels allowing for the carriage of more passengers they fail the unconscious user. When the head drops forward shifting the center of gravity in front of the center of buoyancy the unconscious users slowly rocks forward covering their airway with water. An accurate simulation of loss of consciousness involves the production of minimal or ideally no kinetic energy. Under current efforts to review validity of current three stroke test methodologies, newer static tests of currently fielded Tested and Approved product although low volume, comfortable and stowable, fail to turn them into a face up position within the mandated 5 seconds.

The current standards are the product of a very large committee. 190 countries each advocating the interests of their individual manufactures has led to an assembly of contradictory mandates. For example, one has to be able to swim, while wearing the Life Jacket, a distance that exceeds what the average American is capable of swimming even without a Life Jacket. One needs to be able to climb into a life raft which is very challenging even when the individual is not wearing a PFD. The Life Jacket needs to position the user upon completion of the corrective turn simultaneously within narrow limits for freeboard, head angle, body angle and face plane while not obstructing the view of the horizon. The same comfortable, snug, low profile Life Jacket

must be stable in mounting seas. One size needs to be able to fit anyone and the user needs to be able to put it on from either the front or back in less than 1 minute from the first time the user sees it in the dark. This must all be accomplished in a vest that is so comfortable that it will be worn continuously, so small it will fit under the seat and usually sell for $11.00. Consequently, given these requirements, no current PFDs in the field perform to the standard as denoted in the Federal Code of Regulations.

The third party tester is thus charged with determining whether fielded Life Jackets are capable of rolling an unconscious victim floating face down into and airway protected position within 5 seconds. If the jacket allows a balance to be achieved when conscious, when the wearer looses consciousness, the head drops, moving the center of gravity forward and the wearer's face ends up in the water. At this point the life jacket has the sole responsibility to effect a corrective turning action. Few, if any, fielded life jackets are capable of corrective turning without the assistance of movement on the part of the wearer. Even if a life jacket could reliably turn the unconscious victim into an airway-protected position; the wearer is exposed to airway submersion during the recovery that will result in some degree of aspiration during the corrective turning action. If the amount of aspirated water accumulates to 200 cc the victim moves from near drowning to drowning.

Additionally, the simplest and lightest ballistic vest are Kevlar. In addition to the Kevlar vest the individual might place solid armor plates on the front and/or back. Further complicating the airway protection of the heavily armored individual is the divergent range and location of armaments and gear. As the amount of buoyancy is increased

simply to keep the soldier or officer afloat the shear size of the buoyant device becomes a source of stability in the face up as well as face down situation.

It is to the effective resolution of the shortcomings of the prior art that the present invention is directed.

SUMMARY OF THE INVENTION

The present invention provides a novel PFD that increases the amount of airway protective torque generated by the Life Jacket. Complementing the disclosed separation of the centers of gravity and centers of buoyancy to increase the generated torque are disclosures reducing the amount of torque required by stabilizing the victims head in line with the axis of corrective turning action. The present invention also prevents airway submersion, rather than allowing the victim to fall face first into the water then attempting to recovery the victim within the allotted 5 seconds which is common with conventional PFDs. The creation of an axis of rotation through the waist relies upon moving the ballast posterior and superior while shifting the center of buoyancy down and away from the axis of rotation. This axis pulls the obtunded victim straight back completely avoiding submersion.

The inclusion of ballast in the PFD results in two opposing forces participating in initiation and completion of corrective turning. In one embodiment a solid ballast, such as lead, is used because its high specific gravity allows the smallest diameter sphere per unit mass. The smaller ball can traverse smaller containers, also reducing cost. The smaller contained mobile eccentric ballast occupies less space within the cover of the PFD resulting in the preservation of the amount foam displacement means. In

an alternative embodiment, water is introduced into the container, in lieu of solid ballast. The water is quite heavy when in the air and is uniquely neutrally buoyant when under water. The solid ballast is capable of staying near the perimeter where it reinforces the side high position with its reduced freeboard if not out right airway submersion.

The fluid ballast preferably flows over minor imperfections in the container's inner surface. The relocation of the fluid ballast begins immediately once the victim crosses the inflection point in the corrective turning action. The fluid ballast can relocate on a partial basis, rather than the all or nothing outcome of the solid ballast. While lead shot ballast of small diameter flows similar to a liquid it is not neutral once submerged and may not be reliable in traversing a soft fabric container where water can negotiate and surface with impunity.

The primary goal of the life jacket is to protect the airway upon entrance and during the initial shock that ensues. If trauma occurred prior to entry such as being struck by the boom of a sailboat then face up flotation is critical. If the individual is conscious depending on the water temperature they have sometimes less than an hour to exit the water or suffer a drop in core temperature that will lead to loss of consciousness. The Life Jacket must therefore also carry with it the means to exit the water. Bridging the two chest straps a life raft acts as a cummerbund holding the PFD to user. Once stable the PFD is removed.

The present invention also provides a valise that is securely attached to the life raft so that as the raft kites during inflation it will not blow away across the seas.

Assisting this is a wrist lanyard at the opening of a windsock inflation means. The windsock is held aloft till full, then the neck is closed and the entrap air milked into the chambers of the raft either simultaneously or sequentially through the use of different pressure relief valves. Due to the extreme difficulty of controlling a six-foot inflatable in high winds a secondary body lanyard attaches the raft to the victim. If there is no wind the windsock can be shaken to scoop up air and then transfer that air to the raft. This rapid inflation occurs without the use of expensive, heavy, bulky compressed gas and inflation apparatus, which requires frequent maintenance and fears of failure at many points. Additional novel uses of the windsock further improve safety and survival at sea such as filling it with water to serve as a sea ballast, which helps hold the raft to the water's surface. In the event that the raft overturns on a breaking wave the sea ballast quickly reorients the raft and its victim if securely restrained within the raft.

A quick release cover serves not only to keep the victim aboard if it happens to overturn, but also to protect the victim from sunburn, as well as serve as a means to capture rain or wind as the weather improves. Approximately, one half of the cover can be quickly releasable in the event that the raft does not flip back over, when overturned, to allow the victim to slip out. When the windsock is attached at multiple points, one can preferably be the center of the body where it inflates the floor as well as one or two perimeter points of inflation. Once in the raft the windsock opening can be closed converting it into a sea ballast bag. A fill tube accessible to the raft's occupant allows the ballast bag to be filled. The ballast fuses the raft to the

water's surface and supplies a massive keel in the event of broach.

If the seas are not breaking, the windsock can be detached and the reinforced perimeter attached at three points identified by grommets to allow the windsock to serve as a steering sea anchor orienting the raft in the waves. Once the storm is over the windsock with reinforced receiving pouch and lash cord can be attached to a paddle handle and serve as a spinnaker or sail as the victim attempts to move towards shipping lanes to improve chances of rescue. The windsock can be constructed from waterproof coated fabric and can also serve as a funnel to collect and store rain water. If the windsocks inner face is black or dark the inclusion of a piece of clear plastic allows the construction of a solar still capable of capturing potable condensate.

Thus, the invention provides for a fluid ballast, alone or in combination with a solid ballast means, that is functionally directed to different locations within the boater's personal flotation device or diver's Buoyancy Compensator BC through a rigid or flexible container. Complementing the effect of the shifting ballast on the PFD's airway protective turning action is the torque generated by the structurally enhanced buoyant means. The invention allows both the amount of ballast and buoyancy needed to effect reliable face flotation to be reduced to their minimum by a disclosed inverted configuration of the buoyant moment. Shifting the center of buoyancy away from the axis of rotation creates a longer arm and thus more torque per unit of displacement. Further the inverted configuration results in the buoyant force acting through the apex of its triangular configuration creating a hinge

which confers flexibility. That flexibility allows the buoyant moment to shift off to the side thereby helping to initiate turning.

The size of the connection between the inferior anterior buoyant means and the posterior superior cervical ballast allows escape of the submerged buoyant means to initiate turning. If the apex is overly narrow without the buoyant means moves without control, dissipating the energy needed for rotating the victim's face out of the water. The apical joint also flexes about the thorax increasing comfort. In addition the triangular configuration establishes an open space to allow unimpeded arm movement during swimming as required for PFD approval.

The integration of ballast and buoyant moments into a continuous structural base layer improves transfer of torque from both the fluid/solid ballast and the opposing extended buoyant arm. The particular arrangement disclosed allows the unconscious victim to be pulled straight back thereby avoiding face down flotation rather than first allowing face down flotation then attempting to roll them over onto their back. The prevention of drowning relies upon a new described turning action about an axis through the waist. The disclosed product because of its combined use of dual arms demonstrates marked improvement in classic rotation about the spine previously the only identified or assessed corrective turning action. The disclosed adjustable cervical collar includes a mandibular shelf preventing both anterior posterior movement as well as side to side movement.

Controlling the considerable ballast of the head reduces the amount of torque required of the transpontine ballast and buoyant moments. In current automatically inflated PFD on face first entry, the neck is driven through

the jacket opening and product failure consistently occurs. To assist in controlling the head and neck, the present invention provides overlapping and pneumatically compressed locks assist in maintaining necessary control of the heads ballast. Decreased need for torque converts into a smaller PFD leading to increased comfort, compliance and therefore improved utility in preventing drowning. Due to mounting concerns from wave tank tests about drowning while floating face up several novel airway protective devices are disclosed that complement the airway protection that arises from either prevention of airway submersion or the rapid recover from the face down position in the event it occurs.

Furthermore, compliance with children is a serious problem, the child's vest is not only improved functional fluid ballast, its inclusion in a clear tube with brightly colored fish swimming around as the water moves improves the chances of being worn as well as providing enhanced airway protection. Additionally, survival at sea, if one does not immediately drown, is proportional to the rate of heat loss or passive intrusion of water from breaking waves. Disclosed is a rapid manual inflation means for a personal raft stowed within the back of the PFD. After inflation, the means of inflation can be used as a sea anchor to orient the vessel in building seas. In breaking seas the inflation means can be converted to an Icelandic sea ballast to secure the raft to the waters surface. Once the storm had past the detachable inflation means can then be held aloft to function as a sail to move the raft towards shipping lanes to improve chance of rescue. The raft inflation means constructed of coated fabric now acts as a funnel to collect and store rain. If constructed of dark coated fabric and can be combined with a clear cover and now serve as a solar

still, dramatically extending the duration of safety and survival at sea from an hour to weeks.

Thus, in one embodiment the invention provides for a fluid ballast, alone or in combination with a solid ballast means, that is functionally directed to different locations within the boater's personal flotation device ("PFD") or diver's Buoyancy Compensator BC through a rigid or flexible container. Complementing the effect of the shifting ballast on the PFD's airway protective turning action is the torque generated by the structurally enhanced buoyant means. The invention allows both the amount of ballast and buoyancy needed to effect reliable face flotation to be reduced to their minimum by a disclosed inverted configuration of the buoyant moment. Shifting the center of buoyancy away from the axis of rotation creates a longer arm and thus more torque per unit of displacement. The invention provides a vertically eccentric PFD, combining inferior and anterior shift in the center of buoyancy with superior posterior shift in the center of gravity, generating torque needed for improved corrective righting action of the PFD.

In another embodiment, the present invention also provides a multi-chambered high torque PFD for powerful corrective turning action of a weighted individual. Disclosed is a multi- chambered device capable of being adjusted to provide a wide range of buoyancy as might be needed under differing degrees of ballistic protection. The disclosed eccentric mobile buoyant system complements the massive displacement required to float the armored victim by providing the energy required to reliably initiate corrective turning action, regardless of the gear worn, position of water entry, or state of consciousness of the wearer. In the event the conscious victim desires to shed

the body armor, a series of quick release means allows the victim to shed their ballistics vest while retaining their life jacket.

The individual wearing body armor or heavy equipment on or around the water creates a challenge in the event of sudden entry. In a military setting each strike plate weighs over 9 pounds, typically the individual is also carrying significant armaments, or additional gear. The individual need s not only to float but to be assured that if they injured before suddenly entering the water that an integrated PFD will also orient them into a face up situation. DO to the shear mass attached to their person the buoyant moment attached needs to support the gear as well as the unconscious wearer. As the size of the bladders used to support the armored individual their size creates a secondary problem stability face down as well as face up. Additionally while the use of 9 lbs. of ballast on the back of the victim can augment the corrective Turing action of the integrated life jacket system it is possible that the individual may only have placed a plate on the front of their vest dramatically shifting the centers of ballast and buoyancy. Obviously arrangement of extra ammo, weapons and communication gear may also be of assistance like wise it may also be a detriment to the life jacket system. Further it is desirable that the Life Jacket be able to be activated while wearing the body armor but latter the victim may desire to drop their body armor with out loss of their life vest and thus it is desired that the integrated life jacket upon separation from the heavily ballasted body armor continue to provide reliable airway protection. Currently there are no ballistics vests that provide the unconscious victim with reliable corrective turning action yet alone to

consistently provide airway protection under the wide variety of conditions disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a posterior view of a vest style personal flotation device ("PFD") illustrating middling mobile ballast.

FIG. 2 is a cephalic view of a victim wearing a vest style PFD illustrating the eccentric positioning of mobile ballast.

FIG. 3 is a side view of a mobile ballast attachment means illustrating numerous components facilitating mobility of the ballast member.

FIG. 4 is a cephalic view of a victim wearing a vest style PFD illustrating a freely mobile ballast within a container that redirects the ballast's movement as the victim rolls.

FIG. 5 is a lateral and cephalic view of the mobile ballast's container illustrating the multiple points of stability, as it is reoriented in three dimensions.

FIG. 6 are lateral views of a deflated then inflated PFD illustrating stowage then deployment of the ballast member.

FIG. 7 is a posterior view illustrating a dual position minimally active eccentric fixed keel that can be released by the wearer into a maximally active mobile position.

FIG. 8 is a posterior view showing an immobilized ballast member that can be released by the wearer into an active mobile position.

FIG. 9 is a posterior view of a yoke collar PFD with an attached mobile ballast contained in a sealed semi-circular container.

FIG. 10 is a lateral view of a yoke collar PFD illustrating a PFD in accordance with the present invention constructed to accommodate a recyclable contained mobile ballast member.

FIG. 11 is a posterior view of a yoke collar style or stackable PFD illustrating an externally attached eccentric cylindrical container for a mobile ballast member that can be put in place without having to remove the jacket.

FIG. 12 is a lateral view of a yoke collar PFD showing the integrated form of FIG. 11 where the mobile ballast and containment means are embedded in the foam of the neck of the jacket.

FIG. 13 is a lateral view of a yoke collar PFD while being worn and showing multiple external pouches built into the fabric of the jacket that allow the user accessible adjustment of an amount of ballast without having to remove the vest.

FIG. 14 is a posterior view of a cervical portion of a yoke collar style PFD illustrating eccentric placement of quick release mobile ballast members, one of which can preferably be added while wearing the PFD, one of which preferably cannot.

FIG. 15 is a right anteriolateral view of a yoke collar style PFD showing an externally attached eccentric fixed ballast system that can be adjusted while wearing the PFD.

FIG. 16 is a posterior view of a thermal protective suit illustrating multiple fixed and mobile ballast and buoyant members.

FIG. 17 is a posterior view of a yoke collar style PFD illustrating a fixed hemi-circumferential ballasting member.

FIG. 18 is a posterior view of a yoke collar style PFD illustrating a mobile ballast secured via multiple

attachment points crossing a victim's midline within a ventilated container.

FIG. 19 is a posterior view of a yoke collar style PFD illustrating a mobile ballast secured via multiple attachment points crossing a victim's midline secured to a PFD strap but otherwise open for unlimited range of motion.

FIG. 20 is an anterior view of an individual wearing a yoke collar style PFD, illustrating an eccentric, fixed combined illumination and ballast means.

FIG. 21 is an enlarged view of a combined illumination and ballast means showing thickened high density walls, extra batteries, variably sized high density solid base plug and neutrally buoyant packing material.

FIG. 22 is a left lateral view of a vest style PFD illustrating left anterior buoyant globe appliance and posterior mobile ballast power means.

FIG. 23 is a posterior view of a vest style PFD illustrating fixed horizontal ballasting batteries connected to eccentric transmitter means.

FIG. 24 is a left anterio-lateral view illustrating a two part PFD with eccentric central anterior buoyant means and second cephalo-cervical buoyant means with dual arm mobile ballasting battery means.

FIG. 25 is a frontal view of yoke collar style PFD foam members showing existing and disclosed alternate configurations for internal foam layers.

FIG. 26 is an anterior view of stacked foam layers preserving uniform foam thickness throughout the PFD.

FIG. 27 is an anterior view of stacked foam layers with interlocking layers which result in an increased cervical displacement relative to ventral component.

FIG. 28 is a frontal view of a yoke collar style PFD oversized and complete single piece base foam layer.

FIG. 29 is a frontal view of PFD stack layers comprised entirely from continuous single piece layers.

FIG. 30 is a frontal view of a PFD stack comprised of a single piece over sized base layer with the balance being two piece layers with the joints all on one side opposite the ballast.

FIG. 31 is a frontal view of a PFD stack comprised of single piece over sized base layer two piece layers with the joints on alternating sides.

FIG. 32 is a frontal view of a PFD stack comprised solely of two piece layers with the joints located at the posterior cervical midline.

FIG. 33 is a cross sectional view of a cervical area of a yoke collar style PFD illustrating attachment of combined ballast and appliance to oversized foam base, coated fabric shell and 90 degree two part stiffener means the lateral component of which may be constructed of high density material.

FIG. 34 is a left lateral view of a yoke collar style PFD illustrating amplified cervical displacement means relative to reduced ventral means and attachment of combined ballast and appliance member to oversized foam base/fabric shell held securely by foam layer compressing chest strap(s).

FIG. 35 is an enlarged view of a cervical-ventral joint of a yoke collar style PFD illustrating an externally attached rigid swing arm attachment of eccentric mobile ballast.

FIG. 36 is a left lateral view of a yoke collar style PFD with combined ballast and signaling device attached via an integrated 90 degree swing arm.

FIG. 37 is an enlarged view of a left lateral cervical-ventral joint illustrating the location of buoyant stop and ballasting swing ends of combined ballast and signaling device with pivoting attachment means parallel to the anterior face of the PFD.

FIG. 38 is an enlarged anterio-lateral view of a yoke collar style PFD illustrating secure, rigidifying standardized integrated mounting means of combined ballast and appliance.

Figure 39 is a right lateral view of an interior structure for a vertically eccentric Life Jacket in accordance with the present invention.

Figure 40 is a frontal view of the bell-bottom ventral buoyant means of the vertically eccentric life jacket.

Figure 41 is a superior view of the position of the gas liquid container within the posterior cervical layers of the adjustable collar.

Figure 42 is a frontal view of the vector analysis of the combined effects of contained mobile eccentric ballast and inverted ventral buoyant means.

Figure 43 is a frontal view of an inflatable PFD modified with mandibular shelf baffle and self locking pneumatically compressed vertical baffle closure means with oral nasal splash diverter system.

Figure 44 is an anterio-lateral three quarter view of overlapping layers of adjustable cervical collar.

Figure 45 is a superior view of a neutrally buoyant mobile solid and liquid ballast retrofit means.

Figure 46 is a superior view of a fabricated rigid container for mobile or mobile and liquid ballast means.

Figure 47 is a superior exterior view of a PFD showing a vent means and mounting site for a combined ballast and battery means to reversibly replace fixed midline ballast means.

Figure 48 is an anterior view illustrating the mobile eccentric buoyant means attached via flexible arm.

Figure 49 is a superior view illustrating a rigid container combining fluid and solid ballast shaping the foam into a convexity cradling the head.

Figure 50 is an anterior view illustrating an inflatable PFD or diver's jacket incorporating an overlapping inflatable lock and demonstrating oral nasal splash guards.

Figure 51 is a superior view of the contained mobile eccentric ballast and fixed midline ballast elements conforming variably sized cervical foam collar.

Figure 52 is a superior three quarter view illustrating a folding PFD with dual position inferior stored and anterior active buoyant member.

Figure 53 is an anterior view illustrating an alternative adjustable collar that maintains the continuous base layer and allows for rotation of the ventral arms to for entry and adjusting the diameter of the neck opening to the wearer.

Figure 54 is a superior three quarter view illustrating conformation of the inner welded container for a mobile liquid ballast to outer fabric tube cover directing shifts in ballast location within the adjustable cervical collar.

Figure 55 is an anterior view illustrating the use of fabric outer shell to shape an over sized inner air

retentive bladder. The sewn fabric shell allows the creation of shapes not easily accomplished by single walled inflatable jackets. In this particular application allows the creation of an effective cervical lock preventing the head from sliding down between the ventral buoyant arms on face first entry into the water.

Figure 56 is a lateral view illustrating the location of the mobile ballast container on a plane parallel with the water's surface. The cervical foam structure has a complementary angle specific to the particular PFD and the interaction of the displacement of the collar on a person in the water.

Figure 57 is a lateral view illustrating the use of an inferior chest strap to retain but not restrict the motion of the lower mobile buoyant member. Rigid apical interface allows lower resistance to rotation of the apex of the lower unit about the upper ventral buoyant member. Lateral neck opening decreases chance of the neck moving forward and shifting the center of gravity into a face down position.

Figure 58 is a lateral view of a life raft in accordance with the present invention illustrating a windsock inflation means releasably secured to life raft. Wrist and body lanyards keep the raft from blowing away during inflation before the sea anchor is filled.

Figure 59 is a lateral view illustrating use of windsock inflation means as a sea ballast for the life raft connected by windsock wrist lanyards.

Figure 60 is a lateral view illustrating the windsock means functioning as storage valise built into the cummerbund of the life jacket. Shoulder straps attached to valise allow independent usage of life raft.

Figure 61 is a lateral view illustrating use of the windsock as a funnel to collect and contain condensate from solar still.

Figure 62 is a lateral view illustrating the windsock disconnected as an inflation means and reconnected to the raft as a steering sea anchor.

Figure 63 is a posterior three quarter view of a child's vest style life jacket illustrating the use of a clear mobile fluid ballast container with brightly colored sea creatures in colored fluid.

Figure 64 is a superior lateral three quarter view illustrating the use of the cervical foam means to create a rigid container for an over sized inner bladder holding mobile eccentric liquid ballast along the perimeter.

Figure 65 is a posterior view of the diver's jacket illustrating the superior and lateral placement of mobile fluid ballast for improved corrective turning action.

Figure 66 is a three-quarter frontal view of a multi-chambered life jacket demonstrating dual lift chambers combined with dual mobile eccentric buoyant chambers.

Figure 67 is a side view of the abdominal chambers showing the inferior and superior bladders attached in the tightest configuration producing the lowest volume/lowest profile abdominal bladder.

Figure 68 is a side view of the abdominal chambers showing the inferior and superior bladders attached to the garment and to each other to produce the next lowest volume bladder.

Figure 69 is a side view of the abdominal chambers showing the inferior and superior bladders attached only at base allowing the bladders to increase their volume to near maximum.

Figure 70 is a side view of the abdominal chambers showing the inferior and superior bladders attached together with only the superior bladder attached to the garment, allowing complete inflation therefore maximum displacement.

Figure 71 is a side view of a stowed abdominal bladder demonstrating pneumatic release of the PFD from the stowed state as well as a quick release means for allowing the abdominal bladder upon release to be converted into a free standing Life Jacket. The PFD release mechanism is integrated into the armored vest quick release system.

Figure 72 is a side view of a stowed PFD ready ballistics vest demonstrating a removable abdominal bladder. The vest is constructed with complementary attachment means so that the vest can be upgraded to include the PFD means as an option at a latter date.

Figure 73 is a garment with a built in variable volume abdominal bladder.

Figure 74 is a superior view of an inflatable collar demonstrating an interior angle that upon inflation pulls arm across neck opening opposing complementary fabric lock securing the position of wearers neck in the event of loss of consciousness.

Figure 75 is an inferior view of an automatic closing and locking inflatable collar showing quick release means.

Figure 76 is a posterior view of ballistics garment with water activated self deploying raft.

Figure 77 is a three quarter superior view of secure means for locking zippers in the field. All zippers reversible affixing life saving devices to garment can be quickly secured in particular the zippers used to mount the PFD container to the vest and the buoyant bladders to the container.

Figure 78 is an anterior view of wind breaker garment with integrated single chamber low volume life jacket

Figure 79 is an anterior view of double layer bladder comprised of two bladders of different volume different pressure and different inflation means allowing the use of a single low cost CO_2 cylinder to provide some initial assistance while user completes oral inflation of the larger chamber. To minimize cost the chamber share a wall in common

Figure 80 is a superior view illustrating internally mounted CO_2 in a single use bladder that can be replaced within the garment. Protected from water and corrosion chemically and inaccessible so that cylinder will not be accidentally removed and connected with detonator so that it will not loosen prior to use. Actuated by squeezing or striking the detonator through the bladder wall.

Figure 81 is an anterior view illustrating an extremely low profile PFD to be stowed in the waistband of shorts or to be cosmetically invisible within boating garment such as a shirt.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figures 1 through 8 illustrate swing keel embodiments for a ballasted personal flotation device ("BPFD") which allows the use of a relatively small (light) keel (weight/ballast) to enhance comfort and compliance of a personal flotation device ("PFD") while retaining the efficacy necessary to self rescue a unconscious victim. PFD is defined, for all of the above and below disclosure, to include all various traditional personal flotation devices, as well as buoyancy compensators, and other types of dive gear. While permanent eccentric placement of the ballasting member achieves enhanced rotation, it leaves the victim

floating off to one side, placing one corner of the mouth in closer proximity to the waters surface i.e. decreasing freeboard, a parameter used by testing laboratories to determine PFD efficacy. The placement of the mobile ballasting moment 1a on a centrally attached flexible 2a or rigid arm 11a allows movement of the keeling member towards either the left or right side. Once set in motion the keeling moment gains momentum, accelerating the victim about their axis of rotation, towards the position of greatest stability i.e. where the ballasting moment is suspended beneath the center of buoyancy rather than balanced above it and the victim's airway is consequently positioned out of the water.

The keel's arm can either be flexible 2a or rigid 11a. The swing of the keel is preferably constrained such that its course allows access to the left or right about a caudal arc but restricted in its cephalic swing such that the ballasting member cannot strike the victim's head. The location of attachment 6a of the keel's arm can be variable as dictated by location of the PFD's buoyant members or the individual's anatomy, i.e. such as one who has had a lung or limb removed with its dramatic impact on surface positioning. In general a central positioning provides the greatest symmetric freeboard. The keel's range can be limited by rigid 13a or flexible 5a member that constrains range of motion but ideally without impinging upon the ballasting member in such away that it would impair freedom of movement. A rigid cover 13a is preferred in protecting the head of the victim from being struck by the keel and provides reliable constraints upon the lateral and posterior range of motion. To reduce cost, a fabric cover 5a sewn

above the keel arm 2a can alternatively be provided and determines the keel's lateral and posterior range of motion.

To enhance mobility of the keel a spherical design 1a promotes easy rotation about its arc, though other shapes are considered within the scope of the invention. Comfort, aesthetics and therefore compliance argue for a portion of the keeling member to be more cylindrical 14a to reduce the protuberance of the keel from the back of the PFD.

A swivel 3a integrated into the flexible arm 2a or rigid arm 11a of the swing keel can be provided to reduce resistance of the ballasting member rolling along its arc. Swivel 3a eliminates the opposition to rotation that can arise from twisting the rigid or flexible arm that attaches the keel to the BPFD and/or eliminates the drag that can arise as the keel is skidded or dragged along the surface rather than rolled.

Modification of the dorsal surface of the PFD into a complementary convexity 4a further reduces the incidence of the center of ballast to be stabilized above the center of buoyancy. While the foam of the jacket could be shaped into a convex surface 4a to meet this need, the storage of the BPFD might result in the high density keel deforming the foam, creating a depression with significant memory such that when the PFD is pressed into use the depression might entrap the keel allowing the victim to once again be stabilized in a face down position. Ideally convexity 4a is formed of some rigid material. The rigid surface can be independent or fused to the PFD's closed cell foam. Rigid convex surface 4a further reduces the coefficient of friction between rolling swing keel 1a and the surface of the PFD over which the keel is rolling. The improved ease of movement of the rigid keel upon the rigid convexity further

contributes to the reduction in keel mass without sacrificing reliable airway protection.

A rigid container 20a can alternatively contain the ballasting member, to be freed from the constraints of the flexible or rigid arm. Fully enclosed the ballast sphere 1a could roll across a surface designed to enhance self-rescue. In the face down position the keel preferably resides on a rigid convexity 4a initiating movement to the left or right lateral gully the lowest point to the left or right upon face down entry into the water. Upon reaching the lateral gully of the container the surface would angle off towards the legs or Caudal gully 22a. This inferior movement of the mobile ballast 1a complements the naturally occurring motion of the victim where the initial axial rotation is supplanted by a pendular motion as the legs swing from the flexed position of the face down position into the extended position of a victim floating face up. The containers third low point, the posterior gully 23a would attract the mobile keel from either the left or right caudal gully 22a, moving the ballast away from the back of the victim, establishing then stabilizing the victim in the safe zone, approximately thirty (30°) degree off of dead vertical. The dangerous zone is identified as vertical to less than approximately twenty (20°) degrees off of vertical, in which position the head of the unconscious victim can flex forward submerging the victim's face and/or seriously compromising the victim's airway. The rigid container 13a provides a three-dimensional rigid surface upon which the keel can easily relocate, directing the mobile ballast 1a through a progressive series of angled surfaces complementing and thereby driving the complex maneuvers associated first with initiation of rotation then converting the victim's rotary motion into a

cephalo-pedal swing and finally stabilizing the unconscious victim in the airway protected surface position known as the "safe zone".

The container if sealed 24a can contribute an inflatable element equal to its displacement minus the mass of the keel, to the buoyant means of the PFD. The "neutral" buoyant mobile ballast "swing" keel can thus be integrated into the body of the PFD, reducing bulk and thereby enhancing comfort appearance and therefore supporting the compliance critical to real world efficacy. Any decrement in comfort is outweighed by the superior performance of the BPFD over current PFDs.

The BPFD shifts the onus of rotating the unconscious victim from buoyancy alone to a system combining ballast and buoyancy. The secondary gain associated with the advent of the BPFD is that buoyancy now relieved of the task of rotation can be relocated from the ventral area to the peri-cervical-cephalo area where its displacement can be employed to improve freeboard enhancing victim viability in an inclement sea state rather than sitting uselessly above the water line upon the chest of the unconscious victim. Additionally, with the improved physics of self rescue accomplished by using a combined ballast/buoyant PFD, some of the buoyancy previously employed for rotation in prior art PFDs can be eliminated reducing bulk and further increasing comfort and compliance.

For the individual occupied around the water environment, a soft coating of the mobile keel 26a and/or inner surface 25a of the container can be provided to mute the sound of the movement of the ballasting member 1a, promoting day in/day out comfort and compliance while retaining the advances of BPFD's reliable airway protection.

Environmental concerns mandate that the keeling members, ideally of high density comport with environmental responsibility. Given the life span of the fabric bodice of the PFD it is preferred that a non-lead keel be selected, though such is not considered limiting. The corrosive marine environment can be negotiated by an epoxy coated ferrous material that would exceed the life span of the other component of the PFD and not lead to a lead recovery problem.

There is currently a movement under way to convert the current complex classification of PFD's which is Type I through V into a more succinct and clear labeling of life jackets, Type A & B. Clear labeling would identify Type A as Airway Protective and Type B as a Buoyant Aid but not airway protection. The Type B can be identified with a pictograph showing a slash across a victim floating in a face up position. Complementing the new direction in PFD nomenclature, a quick release coupling 12a in the swing keel's arm 5a can be provided to allow the recreational boater required to wear PFD to comply with the law by routinely wearing a Type B Buoyant Aid, but in the event of deteriorating weather or impending emergency the connection of ballasting member 1a would allow the boater to upgrade the performance of their Type B PFD into a Type A Airway Protective PFD.

For the individual engaged in or about water, mobile ballast member 1a can be restrained in an inactive position 42a until released in the event of an emergency into its central active position 44a. Such release converts the BPFD from Type B into Type A. Ideally the outer shell of the PFD 50a continues down towards the waist to envelope a secure belt 40a to which the inactive immobilized ballast member

41a is secured by a quick release means 42a. In one embodiment, a pair of hook and/or loop fastening members can be closed or the immobilized ballast member 41a by a releasable piece of hook and/or loop fastening member connected by a pull cord 43a to the front of the BPFD. The secure belt holding the ballast in close and tight proximity to the body of the wearer 8a allows the ballast to be comfortably borne by the hips of the wearer rather than swinging about on their back. The dual position BPFD is preferably used with active water sports where the decision to convert from Buoyant Aid to Life Jacket occurs rarely, in contrast to the commercial Type A jacket which is only donned in the event of an impending emergency water entry.

Additionally the mobile ballast 1a can be specifically adapted to inflatable PFD where it is stowed and restrained within the cover. Upon inflation of the buoyant chamber the mobile keel would be released into its active position.

Some of the advantages achieved with and/or features of one or more of the embodiments illustrated in Figures 1 through 8 include, but are not limited to, the following: (1) Mobile ballast member integrated into the buoyant means of a personal flotation device; (2) Mobile ballast member attached to life jacket by flexible means; (3) Mobile ballast member attachable at variable positions to the life jacket by flexible means; (4) Mobile ballast member attached to life jacket by flexible means held in inactive position until released; (5) Flexible means connected through swivel to ballast member; (6) Flexible means connected through quick release coupler to ballast member; (7) Mobile ballast member attached to life jacket by rigid means; (8) Rigid means connected through swivel to ballast member; (9) Rigid means connected through quick release coupler to ballast

member; (10) Ballast member of spherical configuration to facilitate movement along arc; (11) Rigid convex surface over which ballast member rolls throughout the arc of rotation determined by attachment means; (12) Rigid convex surface integrated with displacement foam of life jacket; (13) Rigid cover limiting range of motion of ballast member; (14) Flexible cover limiting range of motion of ballast member; (15) Enclosed container restricting range of motion of ballast member; (16) Enclosed container with convex surface - With second intersecting surface angled caudally - With third intersecting surface angled dorsally; (17) Enclosed container permanently sealed off to create buoyant means, less than, equal to or greater than ballasting means; (18) Enclosed container reversibly sealed off to create buoyant means, less than, equal to or greater than ballasting means; (19) Container and or ballast means coated with sound absorbing material; (20) Mobile Ballast secured quick release inactive position - Secured to belt about waist; (21) Belt loosely connected to PFD contained in Fabric of outer shell; (22) Quick release mobile ballast secured to crotch strap securing PFD to wearer; (23) Mobile ballast immobilized within storage shell of inflatable PFD, released upon inflation; and (24) Inflatable.

Figures 9 through 15 illustrate the eccentric fixed and mobile ballasted life jackets embodiments of the present invention. While sufficient ballast placed along the posterior midline of a PFD will create instability of the face down position and therefore eventually initiate the airway protective roll, central positioning requires significantly more ballast and time to destabilize the face down position. The current invention provides several embodiments that allow a relatively small keel to achieve,

more rapidly and comfortably, reliable airway protection. Given that a stackable Type 1 PFD only weighs 3-5 lbs., the addition of excessive amounts of high density ballast is quite noticeable and uncomfortable to the wearer. Previously discussed tank mounted ballast for a typical midline keel weigh from the 6-8 lbs. The present invention reduces the weight to 1-2 pounds of highly effective eccentric mobile ballast.

In the fixed posterior midline position discussed above, the keel is stabilized directly above the center of buoyancy, the horizontal distance of the keel from the axis of rotation is consequently zero and the rotational energy generated by the fixed midline keel is also unfortunately zero. A keel located top dead center is described as being at zero (0°) degrees on the circumference about the victims axis of rotation.

When the keel is at ninety (90°) degrees the horizontal distance from the axis of rotation is at its maximum and therefore, for a given amount of ballast, so is the effort applied in rotation of the victim about their axis. When the keel is at one hundred eighty (180°) degrees it is suspended directly beneath the victim and the entire system's center of buoyancy. The effect of gravity upon the keel at one hundred eighty (180°) degrees is straight down once again i.e. no energy is being applied in an attempt to rotate the victim about their axis. This position, with the keel one hundred eighty (180°) degrees, places the victim face up airway protected and is the only stable moment in a correctly ballasted self rescuing BPFD (Ballasted Personal Flotation Device). In the event that a large wave throws the victim over onto their face, once again the keel will seek

its lowest point, suspended directly beneath the center of buoyancy, restoring airway protection.

The rate of self rescue is dependant upon numerous factors in addition to size of the keel and are discussed below. Compliance (the presence of the Life Jacket on the victim at the onset of a water emergency) has been shown to be critical in drowning prevention as opposed to the PFD carried aboard the vessel but stowed rather than worn. The eccentric mobile ballast of the present invention by either its site of attachment off of the midline or its rapid movement away from the midline is able to initiate the self rescue roll with relatively less energy input i.e. less weight. The eccentric keel optimizes the rotational energy per unit mass allowing reliable airway protection to coexist with wearer comfort which has been shown to be a non-negotiable bottom line necessary to achieve real world compliance and therefore efficacy.

There are a wide variety of prior art life jackets, with each design group unique in how they locate ballast about the victims neck and torso. What is referred to as the stackable PFD is a flat PFD that allows easy stowage. Some jurisdictions require the highest rated Life Jackets to roll a face down unconscious victim into and airway protected position within five (5) seconds in calm fresh water. Figures 9 through 15 illustrate a Yoke Style Collar or stackable PFD 66a having pericervical buoyant means 71a that supplies the displacement of the cervical collar 72a. Figure 67 shows a relatively simple, reliable attachment means for securing one or more ballast moments to the perimeter of an existing PFD. Without any ballast the existing PFD is a buoyant aid, i.e. only capable of airway protection if the conscious wearer can position themselves in a face up

position. This buoyant aid may be all that can be tolerated or necessary. If an emergency were to arise and the wearer was in warm water wearing minimal clothing a single ballast element is sufficient, if the emergency arise in an inclement environment in which the impending water victim is wearing thermal protective clothing, two or more elements maybe required to right an unconscious victim draped in water logged clothing. The eccentric ballast attachment member 126a is preferably comprised of a cylindrical ballast 100a which is threaded onto a strap 124a. The strap is secured by attachment means 121a to the mounting strap 120a that envelopes the PFD. The mounting means 120a is secured by fastener member 122a which preferably makes a reliable connection by relying upon multiple overlapping surfaces. If this closure mechanism were to fail the ballast would drop away and the life jacket would be reduced back to an airway submerging buoyant aid. Similarly cover strap 123a secures and protects the ballast belt 124a from being snagged and possibly released with the same consequences described above. Stiffener 125a supplies critical rigidity necessary to prevent ballast 100a from sliding from its position on the PFD's lateral surface onto the PFD's ventral, dorsal or medial surface where the selected ballast may be insufficient to effectuate the self rescue roll. Notably ballast 100a is specifically selected so that it can be transferred to an integrated mobile ballast PFD as shown in Figure 12. Once the ballast is located in a tubular containment member 87a it can be continued to be used indefinitely, allowing its cost and ecological impact to be minimized.

Typically, a PFD's inherently buoyant means is comprised of multiple layers placed symmetrically about the

wearer. However, the size of eccentric ballast can be reduced removing a portion of the buoyant means whether inherently buoyant, inflatably buoyant or of mixed origin. The eccentric placement of buoyant means about the PFD can be used to facilitate the self rescue roll by reducing the symmetry as well as by reducing the size of the buoyant moment that must be submerged by the ballast during the initiation phase of self rescue (zero to ninety degrees).

The fixed, eccentric ballast as shown in Figure 13 integrated into the construction of a new PFD locates the containment means 101a in an accessible area for wearer manipulation in the field. Significantly the jacket does not have to be removed in order to convert the jacket from a buoyant aid device into a Life Jacket with varying strengths of active self rescue. Figure 15 shows a "fix" for PFDs currently in existence. The eccentric fixed ballast means 100a are only applicable to those select PFDs which through specific placement of the buoyant means of the PFD, only need assistance with the initiation phase of the self rescue roll, i.e. zero (0°) to ninety (90°) degrees. Once PFDs of this design are moved out of the stable face down position the buoyant means alone is capable of completing the phase two of self rescue, i.e. ninety (90°) to one hundred (180°) degrees.

Other PFD designs in order to achieve reliable airway protection with minimal amounts of ballast require mobility of that ballast means to assist not only with phase one initiation but with phase two completion of active self rescue. A mobile ballast requires a containment means to limit and direct the keels movement to effectuate the conversion of stabilize face down flotation into face up. In PFDs of this design an eccentric fixed keel will roll the

victim off their back and onto their side where they become stabilized in a side high position. However, the unconscious victim's flaccid airway is severely flexed to the point of obstruction and their airway remains submerged. In this side high position the victim often rapidly succumbs to Shallow Water Drowning. Notably both the eccentric fixed and mobile ballast elements rely upon being located off the midline to achieve phase one rotation with a minimum amount of ballast.

As seen in Figure 9, another embodiment is shown where an exterior attachment of a semi-circular container 60a containing a mobile ballast 1a allows existing jackets to acquire active self rescue. Container 60a and mobile ballast is of such a design that it can also be used within the cervical collar of a new stackable PFD. Container 23 and ballast 1 have a longer useful life expectancy than the fabric lives of several current PFDs. This recyclable feature allows the cost to be spread out over many jackets and minimizes the disposal problems presented by high density metals such as lead. Furthermore, the stackable PFD 66a of Figure 11 shows a straight container means 87a within a fabric sleeve 83a attached to a fabric hood 80a secured to stackable PFD 66a by attachment means 81a allowing an in field fix of an existing stackable PFD. One advantage of straight container means 87a is it allows the use of one, two, as well as three or more mobile ballast elements 1a since they all stack up the same corner of the PFD. With semicircular 60a containment means 23a, mobile ballast 1a elements are preferably provided in an odd number (i.e. 1, 3, 5...) to prevent an even distribution of the ballast elements. With only two elements one could be located at each end effectively balancing each other out leaving the victim floating face down. The advantage to multiple

elements is that the container diameter can be reduced allowing easier manipulation as well as comporting with the size restrictions of infant or children's PFDs.

The stacking linear containment means finds slightly divergent applications in other PFD designs. The multiple stacking of the ballast elements moves and facilitates container 23a relocation as is necessary in effecting the first phase of active self rescue (i.e. zero (0°) to ninety (90°) degrees), then the ballast must relocate to the other end to optimally facilitate phase two of the active self rescue roll(i.e. ninety (90°) to one hundred eighty (180°) degrees.

While cervical container means 60a and 87a benefit from being closed in that they contribute displacement in the critical cephalic area, helping to maintain freeboard, the distance measured from the corner of the mouth to the water's surface, when used within the back of a vest style PFD, perforated end caps 101a allow the air to exhaust so that the container's displacement does not oppose the containers relocation during the conversion from phase one to phase two of the active self rescue roll.

Some of the advantages achieved with and/or features of one or more of the embodiments illustrated in Figures 9 through 15 include, but are not limited to, the following: (1) Eccentric Single or Multiple ballasting means, Attached to Inherently buoyant, Inflatable buoyant, or Hybrid buoyant, Personal Flotation device; (2) Fixed Eccentric ballast means; (3) (New Construction) Internal or external Integrated Fixed eccentric ballast member Accessible for placement and or removal, Inaccessible, combination of partially inaccessible with the option to add additional ballasting elements; (4) (Fix of in existing products)

Externally Attached eccentric ballast member, with independent reversible or Permanent attachment means, accessible, inaccessible, mixed; (5) Ballast Means, cylindrical or spherical for use in fixed and mobile ballast systems; (6) Mobile ballast member integrated into the buoyant means of a personal flotation device; (7) mobile ballast member attached to life jacket by flexible means; (8) mobile ballast member attachable at variable positions to the life jacket by flexible means; (9) Mobile ballast member attached to life jacket by flexible means held in inactive position until released; (10) Mobile ballast attached midline; (11) Eccentric mobile ballast member attached at point off midline; (12) Flexible means connected through swivel to ballast member; (13) Flexible means connected through quick release coupler to ballast member; (14) Mobile ballast member attached to life jacket by rigid means; (15) Rigid means connected through swivel to ballast member; (16) Rigid means connected through quick release coupler to ballast member; (17) Ballast member of spherical configuration to facilitate movement along arc; (18) Rigid convex surface over which ballast member rolls throughout the arc of rotation determined by attachment means; (19) Rigid convex surface integrated with displacement foam of life jacket; (20) Rigid cover limiting range of motion of ballast member; (21) Flexible cover limiting range of motion of ballast member; (22) Enclosed container restricting range of motion of ballast member; (23) Enclosed container with convex surface - with second intersecting surface angled caudally - with third intersecting surface angled dorsally; (24) Enclosed container permanently sealed off to create buoyant means, less than, equal to or greater than ballasting means; (25) Enclosed container reversibly sealed

off to create buoyant means, less than, equal to or greater than ballasting means; (26) Vented non-buoyant container for mobile ballast; (27) pivoting straight container attached at laterally, swinging cephalo-caudal; (28) container and/or ballast means coated with sound absorbing material Inflatable; (29) stiffener means; (30) asymmetric buoyant means; and (31) mobile buoyant means.

Individuals employed offshore are often supplied with whole body thermal protective garments 130a as seen in Figure 16. Currently despite the garments massive buoyant moment such individuals are also required to wear a life jacket. The inclusion of eccentric fixed and mobile ballast and buoyant means of the present invention allows the buoyancy inherent in the thermal protective garment 130a to fulfill the dual purposes of warmth and surface support. Figure 16 is a posterior view of one such exposure suit or thermal protective garment 130a. The traditional neoprene suit of a wind surfer or water enthusiast is likewise capable of protecting core temperature as well and is also considered with the scope of the invention. A ventral eccentric buoyant means 131a combines with a posterior eccentric buoyant means 132a to help destabilize the face down position. The addition of multiple ballast members such as a midline mobile ballast system 133a with an eccentric fixed ballast system maybe sufficient for a tight fitting neoprene protective garment. In the exposure suits designed for north sea offshore oil rigs there is a need for peripheral ballast members, 135a and 136a to assure the victim will maintain a heads up position. Preferably, the identified direction of turning is reinforced by the placement of eccentric ballast such that there is sufficient energy to initiate the first phase of self rescue, i.e. the

size of 136a exceeds 135a. In the vertical position this difference is negligible.

Some of the advantages achieved with and/or features of the embodiments illustrated in Figure 16 include, but are not limited to the following: (1) Thermal protective gear with one or more eccentric fixed buoyant means; (2) Thermal protective gear with one or more eccentric mobile buoyant means; (3) Thermal protective gear with one or more eccentric fixed ballast means; (4) Thermal protective gear with one or more quick release eccentric fixed ballast means; (5) Thermal protective gear with one or more eccentric mobile ballast means; and (6) Thermal protective gear with one or more quick release eccentric mobile ballast means.

Figure 17 illustrates a PFD Strap ballast embodiment in accordance with the present invention. One PFD design that is popular in children is a yoke type collar PFD or stackable PFD. The children's PFD does not lend it self to the same solution as the adult, i.e. the eccentric fixed ballast locate along the lateral cervical area. The combination of the child's body density, narrow pulmonary fields and predominance of mass in the cephalic area makes them resistant to the lateral ballast moment. Figure 17 shows the wearer 8a wearing a stackable PFD 72a held by strap 65a. The ballast moment is spread by attachment means 142a along the posterior width of the individual. The ballast may be a lead shot 140a, though such is not limiting. Lead shot 140a, in a soft coating, preferably conforms to the body's surface. Alternatively, lead shot 140a may be comprised of small rigid blocks of ballast such as 141a. The posterior horizontal distributed ballast means 142a is located upon the back of the wearer 8a and held in

place from slippage there from by a stiffener that conforms to the wearer 143a.

Alternatively, in Figure 18 the child 8a wearing an inflatable PFD 31a achieves the keeling action from mobile ballast contained within a container 60a with curved surface 4a. The mobile ballast 1a is preferably attached to both ends ventilated end caps 150a, which allow water end thereby avoiding placement of a counterproductive buoyant moment low on the victim's back. Mobile ballast 1a is suspended from diametric points via left flexible means 151a and a right flexible means 152a. This dual suspension transfers across the midline of the victim to the opposite side of the ballast's location. Figure 19 adapts this dual suspension to a strap attachment means 160a that can be added or built into the PFD strap 65a. Unrestrained mobile ballast 1a is free to roll to either side yet when it reaches the end of its flexible arm 151a or 152a it exerts a turning force across the midline. As the self-rescue roll nears the end of the second phase, the mobile ballast is suspended from both arms and is located in the midline, swung away from the victim, stabilizing them in the safe zone. Due to the lack of a container that invariably restricts motion and consequently location, the open device can be of smaller size for a given rate of turning.

Some of the advantages achieved with and/or features of the embodiments illustrated in Figures 17 through 19 include, but are not limited to, the following: (1) Horizontal band of ballast, fixed or mobile along PFD Strap or belt or back of vest; (2) Body Stiffener conforming sized and conforming to the wearer; (3) Mobile ballast suspend from left and right arms; (4) Attached to PFD Strap; (5)

Contained in ventilated means - With curved surface beneath mobile ballast

ECCENTRIC AND MOBILE BALLAST AND BOUYANCY PARTS LIST (FIGURES 1 through 19)

1a	Mobile Ballast Member
2a	Flexible Arm
3a	Swivel
4a	Curved Surface
5a	Flexible Retaining Cover
6a	Arm Attachment Point
7a	Life Jacket
8a	Wearer of PFD
9a	Lower Edge of PFD Fabric Back Panel Covering Ballast Components
10a	Pivoting Attachment Point
11a	Rigid Arm
12a	Quick Release Coupler
13a	Rigid Retaining Cover
14a	Conical Mobile Ballast
20a	Container for Mobile Ballast Member
21a	Lateral Gully Low Point
22a	Caudal Gully Low Point
23a	Posterior Gully Low Point
24a	Airtight Lid for placing / servicing mobile ballast member
25a	Sound Reducing Coating of inside of Container
26a	Sound Reducing Coating of Mobile Ballast Member
27a	Surrounding Foam of PFD
30a	Stowed Inflatable PFD
31a	Inflated PFD
32a	Deflated PFD Retaining Cover
40a	Secure belt

41a Inactive Immobilized Ballast Member

42a Quick Release Retainer Means

43a Quick Release Activation Means- Pull Cord

44a Activated - Mobile Ballast Member

50a Continuation of Outer Shell of PFD

51a Loop Portion of Hook and Loop Fastening Member/Quick Release Means

52a Hook Portion of Hook and Loop Fastening Member/Quick Release Means

53a Crotch Strap

60a Semi-Circular Container

61a Foam Pad insulating end cap

62a Resealable End Cap

63a Flexible Fabric Joint between Thoracic-Ventral and Cervical-Dorsal

64a Ventral Buoyant Means

65a PFD Strap

66a Yoke Collar Style or Stackable PFD

67a Resealable Closure for container

68a Cervical Foam Pad

69a Semicircular Fabric Hood

70a Resealable Closure Means

71a Layers of closed cell foam

72a Cervical collar of stackable PFD

80a Fabric Hood

81a Hood Attachment means

82a Tube Cap

83a Tube Sleeve Cover

84a Tube Sleeve Cover Opening

85a Tube Sleeve Closure Means, Loop Portion of Hook and Loop Fastening Member

86a Tube Sleeve Closure Means, Hook Portion of Hook and Loop Fastening Member
87a Straight tube Containing Mobile Ballast
88a Second Mobile Ballast Element
90a Ventral Surface of PFD
91a Posterior Surface of PFD
92a Cervical Buoyant Means Embedding Container means
93a Posterior-Medical End of Container Means
94a Ventral-Lateral End of Container Means
100a Eccentric Fixed Ballast Means
101a Ballast Container Means
102a Sealable Container Cover
110a Eccentric Inaccessible Mobile Ballast Element
111a Eccentric Accessible Mobile Ballast Element
120a Mounting Means for addition of Ballast, Strap
121a Attachment Point of Ballast Belt
122a Secure Closure Means
123a Safety Cover for termination of Ballast Belt
124a Ballast Belt for secure mounting of eccentric ballast
125a Stiffener Means
126a Eccentric Ballast Attachment Means
130a Thermal Protection Garment
131a Ventral Eccentric Buoyant Means
132a Posterior Eccentric Buoyant Means
133a Midline Mobile Ballast System
134a Eccentric Fixed Ballast System
135a Single Eccentric Peripheral Ballast Means
136a Multiple Eccentric Peripheral Ballast Means
140a Shot Ballast
141a Solid Block Ballast
142a Posterior horizontal distributed ballast means
143a Stiffener sized to conform to wearer

150a Ventilated End Cap

151a Left Flexible Arm

152a Right Flexible Arm

160a Attachment means for multiple suspended mobile ballast

As seen in Figures 20 through 38 a combined ballast and signaling device which is neutralized by attachment to an eccentrically buoyant PFD is disclosed and generally designated as reference numeral 1b. It is recognized that the role of the eccentric or midline, fixed or mobile, ballast or buoyant moment confers improved airway protection upon personal flotation devices ("PFDs"), which have been defined above. It is disclosed herein that the ballast associated with certain required attachments when appropriately sized, located and if required, minimally augmented, can confer a synergistic dual advantage enhancing airway protection as well as enhancing visibility to search and rescue efforts.

Standards agencies have not only approved but require that certain types of PFDs particularly commercial Safety Of Life At Sea ("SOLAS"), Off-Shore Type 1 Life Jackets carry a lighting or illumination means 2b for assisting in the night time search and rescue efforts of individuals lost at sea. Other individuals making passage on lightly crewed vessels carry telemetry devices 40b that awaken sleeping crew alerting them to a man over board situation as well as demarcating their position on an electronic locating device aboard the vessel. Others advise carrying personal EPIRBS 25b (a signaling device) for assisting their being located day or night while adrift. These and other devices routinely attached to the PFD when specifically sized and located can supply the ballast that is critical in order to replace PFD stabilized airway submersion with active self rescue. i.e. a

PFD that is capable of reliably rolling an unconscious victim's face out of the water without their assistance or reliance upon sea state to initiate the Life Jackets turning.

Since every PFD requires a different ballasting arrangement as previously disclosed, certain PFD designs may require the ballasting/powering element 24b, 37b to be connected to the light, strobe, transmitter, etc., preferably via a conductive cable 23b. Other PFDs, because of their design, lend themselves to a easier solution in which the batteries, case and appliance are all contained at a solitary site, where the mass of the device confers enhanced airway protection while concurrently providing wearer operable access to the signaling device. If necessary, an additional battery 11b or batteries can be added to assure that the requisite ballast requirement is met for active self rescue. Additionally, the materials for the container 12b might be selected to help fulfill a portion of the ballast requirements of a particular PFD, i.e. steel or lead instead of plastic. Further, as some devices exposed to moisture are packed in petroleum jelly 14b to decrease detrimental effects of water within the device, the packaging medium can be selected to meet or exceed the specific gravity of water so that the entire volume of the containment means contributes positively to the ballasting moment rather than sealing in air which would reduce the net ballast moment. A variably sized high density plug 13b can be attached as required by the individual PFD to meet the PFD's specific ballast needs, i.e. the remainder of the ballast and signaling device remains constant but if a particular brand PFD requires 2 lbs. instead of 1 lb., a different plug 13b can be attached. Attachment means 16b

allows quick and secure retrofitting of PFDs in the field. Attachment means 16b can be an arm member, preferably rigid, whose distance from the PFD can be varied allowing the attached appliance increased range of motion and therefore increased efficacy in imparted rotational energy per unit mass of the combined ballast and appliance.

A new PFD would locate grommets to specify the exact location of existing ballasted appliance identifying where a ballasted appliance needs to be attached in order to assure ballast mediated airway protection. O-ring sealed switch 17b allows operation by the wearer. Alternately, the appliance device may be water activated in the event of unconscious water entry.

Ballasted signaling device 1b can be instantly mounted such as by a locking hook and loop fastening strap member 5b or safety pins 16 onto PFDs currently in the field allowing a fix to airway submersion that does not result in the attachment of yet another device to the PFD where it not only clutters the appearance but may confuse an obtunded individual seeking to differentiate their strobe light from their ballast fix (i.e. in the event of hearing a search and rescue vehicle approaching at night). Given the difficulty associated with trying to change regulatory standards to allow the attachment of a purely ballasting member to a PFD with its concomitant reduction in the net buoyancy of a life jacket, a combined ballast appliance device 1b of the present invention, only slightly augmented with additional ballast if necessary, can be immediately shepherded into the field without the paper work and time required to change international standards to accommodate the consequential reduction in the net buoyancy that would occur upon attachment of ballast on PFDs in the field. With newly

constructed PFDs, the placement of the additional eccentric displacement means 101b on the ventral leg opposite the side where the ballast moment is attached 100b will neutralize any effective net loss of buoyancy.

Additionally, the intentional placement of a buoyant member 2b, 34b on the PFD can supplant or complement the need for a ballasting member in order to achieve active self rescue. Buoyancy can be located in several places such as along the ventral midline of the victim 34b, where it alone or in combination destabilizes the airway submerged face down position. As previously disclosed a midline buoyant bubble wants to rise to the surface, shifting the wearer sufficiently off center so that the main buoyant elements of the PFD, with or without attached ballasting means, can come into play and thereby roll the victim over into an airway protected position.

Furthermore, an eccentric placement of a buoyant member 34b, 2b may take advantage of the differences of the right pulmonary fields preponderance of displacement versus the left lung field which is reduced by the volume of the intrusion of the pericardial sac with its fluid and muscular contents. While there is a predictable incidence in which the location of the heart is reversed, it typically is not a factor to be ignored in positioning.

Any container sized, sealed and or selected so as to be sufficiently buoyant, such as the device purely for displacement 34b or one with alternate function such as a means of illumination 2b, can be located in either a midline or eccentric position and if of sufficient buoyancy it alone can shift the victim out of the zero (0°) degree face down position. Obviously, separation of a products buoyant moment from its ballasting moment and thereby positioned to

optimize turning, could combine in a synergistic fashion to accomplish enhanced airway protection while assisting in search and rescue. If additional batteries are needed for ballast purposed, they can also provide for extended operation or increased brilliance and range of signaling devices, that may also prove life saving.

As part of the responsibility for turning over the unconscious victim is borne by ballast, the buoyant means can be redistributed to where more of its displacement is located about the head and neck 33b. In this place, increased freeboard is achieved for a given displacement PFD. A side entry PFD as seen in Figure 24 allows the central ventral position to be occupied by an asymmetric ventral buoyant means 34b where the displacement mimics a horse collar life jacket. The central preponderance creates an instability of the face down position and drives the first phase of self rescue, $0°$ to $90°$ degrees. The lateral ventral component only has to be sufficient to power the rescue through phase 2, $90°$ to $180°$ degrees. Complementing this is the dual arm mobile ballast battery means 37b which is attached across the victims midline so that the rotational energy will be applied past $90°$ degrees. The mobile ballast comes back to a central position once the victim reaches $180°$ degrees or face up. The cephalo-cervical cradle 33 can be securely snugged up by the wearer operating straps 31b locking the head from rolling off to the side. Secure and correctly positioned straps and fasteners are preferably provided to prevent the wearer from slipping down in the PFD. Furthermore, a crotch strap 41b with secure fastener means 42b is also preferably provided for keeping the buoyant moments in their correct position on the flaccid victim.

Figure 25 shows a current configuration for a yoke collar style PFD, generally designated as reference numeral 50b, which includes three pieces of foam that currently comprise each layer, one cervical piece 51b and two ventral pieces 52b. This configuration has been grand fathered in to its current position as an industry standard based on ease of sewing and assembly. Configuration 50b stacks all the foam joints bilaterally in the lateral cervical area. In Figure 20, the locking attachment means 5b not only secures the combined ballast and appliance device and stiffener to the outside perimeter where it prevents the ballast and combined signaling devices migration from the ideal point of attachment, the stiffener also preferably structurally ties together the ventral and cervical foam of the PFD. As seen in Figure 35 the stiffener can be shaped as a right angle where the anterior stiffener 65b can be neutrally buoyant while the lateral stiffener 60b can be constructed out of a high density material and thereby comprise an internal fixed ballast. The combination of stiffeners on two sides preferably locks the combined ballast and signaling device securely to the PFD.

Figure 25 illustrates a relatively simple solution for a newly constructed PFD which preferably includes additional units of ventral foam piece 52b. In a SOLAS grade PFD, depending on the thickness of foam selected by the manufacturer, as little as two additional pieces of foam on top of the usual 8b piece construction produces enough of a difference in the left versus right ventral buoyant members to shift the flaccid victim off center and thus initiate phase one of active self rescue.

Another cost effective configuration for a newly constructed PFD, is a PFD built from a simple two piece foam

layer arrangement 53b then stacked as in Figure 32. This eliminates the lateral joint and thereby allows the attachment of the lateral ballast a more complete purchase on the ventral and a portion of the cervical displacement means.

Adding considerably to the complexity of sewing the fabric shell and then stuffing that fabric shell with the foam layers, are the foam layer stacking arrangements as shown in Figures 30 and 31. An oversized base layer 56b as seen in Figure 33 allows the anterior coated fabric shell 61b and the posterior coated fabric shell 62b to be sewn through the foam base layer integrating the PFD structurally. Currently PFD fabric is uncoated allowing it to stretch and loosen resulting in increased laxity of the cervical-ventral joint. A coated one side fabric can greatly extend the life of the PFD and if the applied SOLAS tape were sufficient and the coating was placed outside there can be fabric protection form UV, petroleum products, salt water, etc. Depending on whether the PFD is designed to be classified as a PFD that will be required to carry a signaling device, the stiffener can be in part or completely comprised of high density ballasting means 60b which can be joined to the fabric and foam at the peripheral seam or encased in a pocket along the side of the PFD. A binding tape 61b covers and reinforces the joint. The combined ballast and signaling means 1b is secured via fastener means 64b at the ideal site as determined by the arrangement of buoyant means in a particular PFD.

Compliance from a child asked to wear a PFD all day long may necessitate greater flexibility of the lateral cervical joint as in the alternating stacking arrangement of Figure 31, yet the base layer and alternating layers supply

improved structural integrity to the foam elements that must effectively receive and transfer the rotational energy from the ballast means to the victim. Figure 30 shows a stacking arrangement which will confer even greater rigidity on the ballasted side since there are no lateral cervical joints. While this results in less flexibility and comfort it increases efficacy per unit mass of ballast. On the opposite side of Figure 82 all the joints lie in a line conferring greatest flexibility for ease of entry allowing the PFD to flex about this joint while donning the device. PFDs constructed as in figures 30 and 31, as do all PFDs, benefit from the inclusion of an eccentric fixed buoyant moment in the side opposite from the side carrying the ballast moment. This can be achieved through the use of foam pieces such as 52b or 55b as sown in Figure 25.

Certain Types of PFDs designed for commercial cold water use where the wearer is likely to be wearing thermal protective clothing can include the foam layer stacking arrangement. Figure 29 is comprised of solid single pieces 57b resting upon an oversized base layer 56b and sometimes capped by another oversized layer conferring the greatest PFD structural rigidity short of solid foam. The use of layers confers a real advantage in conforming the PFD to the wearer and in adjusting to movement by the wearer as the PFD is bent over the wearer and as the wearer bends, twists etc. Ideally such a stacking arrangement includes the minimum buoyant offset such as foam piece 55b, to assure minimal performance under ideal conditions, i.e. tester wearing only a bathing suit as it currently is the sole testing standard despite its short comings when mapped to a real world disaster in the open ocean.

The reduction or elimination of the lateral cervical joint allows the rotational energy of the combined ballast and appliance to more fully applied to rolling the PFD and wearer into a face up position. In current PFDs a lot of the energy is used to deform the fabric shell twisting the lateral cervical joint. The energy that is transferred impacts primarily either the posterior cervical part 51b or the ventral foam part 52b where it acts independently and if the ballast is insufficient to the PFD inadequately attached to the wearer, the ballast will be suspended below the buoyant component allowing the airway to remain submerged. Current PFD foam layer structure requires unnecessarily excessive ballast to be attached in order for the PFD shell to first be twisted, next the ventral component moved then the cervical before the victim can be rolled into an airway protective position.

Ideally, the yoke collar style PFD shape can be retained yet free board optimized while keeping the ballasting appliance to a minimum by using a stacking arrangement as shown in Figure 27. As shown, the PFDs foam layers build upon an oversized base layer 56b. Succeeding layers then alternate partial single piece layers 55b such that there is a preferential build up of displacement behind the head and neck of the wearer. Depending on how many layers are stacked, this can result in an effective conversion of ventral displacement means toward the neck where it can now be used to enhance free board rather than sit out of water upon the chest of the victim where the majority of the ventral foam can be found and where it does not contribute to displacement or free board. This stacking arrangement in a finished PFD is shown in Figure 34. The inclusion of two additional ventral elements on one side

relative to the other incorporates the fixed eccentric buoyant means necessary and sufficient to meet minimal turning performance. Positioning the combined ballast and signaling device on a vertical pivoting attachment along the opposite ventral buoyant means improves the aggressiveness of the airway protective turning moment of such a PFD.

The efficacy of the PFD, as measured by its airway protection, is enhanced if the buoyant ventral means 100b, which in Figure 34 is shown as the right side of the PFD, is constructed with enhanced displacement relative to the left side or ballasted ventral means 101b. This creates an eccentric fixed buoyant means that destabilizes the face down position. If the PFD's differential ventral buoyant means are adequately designed and constructed, an eccentric inherently buoyant PFD can be sufficient to provide airway protection. Ideally, the combination of a ventral buoyant discrepancy combined with a correctly located and attached combined ballast and signaling device provides the PFD with a brisk and reliable rotation of the victim out of the face down position and into the face up position with the least amount of physical divergence from the currently configured PFD as stowed aboard many commercial vessels.

The above advantages as detailed in the PFD constructed from foam layers applies to the solid foam PFD. The enhanced ventral buoyant moment complements the correctly positioned ballast or combined ballast and appliance. That combined efficacy allows for a shift of some of the displacement towards the head and neck where it increases the distance from the waters surface to the victim's airway.

Towards further securing the effective application of energy per unit of ballast 1b towards effective self rescue rotation, is cinching strap 72b, which encircles the ventral

stacked foam layers on the ballasted side of the PFD. Once the PFD is placed on the wearer the foam layers slide into their final position at which time strap 72b is now tightened, compressing the foam layers. Once the strap is tightened it connects the stacked layers to the oversized base layer where they connect to the fabric shell and combined ballast and signaling means. A second strap 73b can also be provided and encircles the opposite ventral stack further unifying the PFD structurally. Certain body types and or use of thermal protective clothing, make the in water vertical position markedly stable and may require an additional posterior cervical mobile or fixed ballast device 75b, similarly attached to the base foam layer and fabric shell of the PFD.

For an individual working in foul weather wearing significant amounts of clothing it can be important to further amplify the rotational energy supplied per unit mass of a ballast regardless of its source. Figure 35 illustrates an externally applied rigid lever arm 80b with an attached 90° degree stop 81b that prevents the ballast from swinging past the 90° degree point. In the active position the ballast is moved away from the victim's axis of rotation and held in this position of greatest rotational impact on the face down victim. A second significant advantage of amplifying the ballast's impact by moving it outboard is that it lengthens the lever arm from the vertical axis, generating the additional leverage needed to pry the flaccid victim out of the face forward slump. When the victim is vertical in the water column in what is called the 'PFD Dangerous Zone', i.e. 0° to 20° degrees from vertical, just before losing consciousness there is a strong tendency for the victim to slump forward when they pass out. If the

victim slumps forward he or she may hang from their PFD, airway crimped and face in the water, where he or she may quickly drown. With the swing ballast at its greatest distance from the victims vertical axis, the victim is rocked off to the side where the ventral buoyancy is now free to rise towards the surface, swinging the person on their back, airway protected.

Arm 80b and stop 81b are preferably connected to a ballast plate 82b upon which can be mounted an attachment cover supporting a range of additional ballasting devices via a quick release attachment means 86b for securing a simple ballast 87b or a combined ballast and appliance such as is shown in figure 21. The swing arm is attached by a secure locking means such as might be comprised of an outer jaw 85b and inner jaw 88b. A stiffener of ballasting stiffener 60b improves the conversion of the torque applied to the tubular arm guide 83b into rotation of the wearer rather than into deformation of the PFD. Figure 36 shows an integrated eccentric mobile swing arm with a combined ballast and appliance device 1b with additional ballasting power supply 11b, regulated by switch 3b power signaling/illumination device 2b. The tubular hinge 83b is preferably secured to the over sized top layer of foam further improving the transfer of the kinetic energy of the ballast into rotation of PFD buoyant means. As the efficacy per unit mass is advanced the buoyant means of the PFD can be reallocated from sub-serving the responsibility of rolling over the obtunded victim to support the flaccid victim's head and neck, i.e. buoyancy can be removed from ventral means 71b and placed behind the head and neck 70b conferring increased freeboard or distance of the victim's nose and mouth from the water line.

SOLAS Life Jackets when used commercially are required to carry an illumination or signaling device, a preferred embodiment of such is shown in figure 37 demonstrates how the combined ballast and signaling means is divided into a long arm that extends towards the rear of the wearer. At the extreme end of the long arm is located the highest density ballast so that when the combined ballast and signaling device swings about attachment means 16b that pivots freely through mounting means 91b, the ballasted end is moved laterally to the point furthest from the axis of rotation. Alternatively, when the victim is floating face up, the long arm of the ballast end swings the device back adjacent the lateral edge of the PFD which now positions the short buoyant arm straight up so that the illumination means 2b is out of the water and visible from 360° degrees. If the victim enters the water face down or is rolled over onto their face by a wave, the long arm of the device swings out approximately 90° degrees moving the ballast to its optimal position of approximately 90°degrees to the victim's axis of rotation. In this position, the ballast is maximally effective at applying torque to the victim and their PFD in order to rotate their face out of the water. As the long arm of the ballasted end of the device approaches 90° degrees the short buoyant arm is simultaneously moved medially where the impact of the buoyancy is reduced to its minimum in terms of opposing active self rescue. The short buoyant arm of the combined ballast and signaling device preferably acts as a 90° degree stop arresting the swing from perpendicular to horizontal relative to the ventral face of the PFD. In the stop position, the short buoyant arm of the device rests against the face of the PFD. Figure 90 shows a preferred embodiment where the short arm buoyancy is reduced to its

practical minimum thereby reducing the need for offsetting ballast. Once the victim is rolled over into a face up position, the ballast swings back in reducing the ballast's distance from the victim's axis of rotation thereby reducing the ballast's impact or lowering the corner of the mouth of the victim towards the water (i.e. thereby maintaining as much freeboard as possible).

Figure 38 also illustrates a secure and simple mounting means for a combined ballast and appliance. Preferably, a sewable plastic piping 92b is integrated into the seam of the PFD spaced to accommodate the appliance's hinge means 91b. The section of tubing can be die cut to be removed leaving the sewable flange so that the space for the appliance can be consistently close for optimal support yet sufficient to allow easy assembly. Hinge pin 93b serves multiple functions; it secures combined ballast and signaling device 1b through the sleeve means integrated into the PFD 92b in a secure but preferably releasable manner. It rigidifies the cervical-ventral joint. The placement of multiple sewn in sleeves 92b which contain their hinge pin 93b, with or without a combined ballast and appliance device, can supply rigidification of the cervical-ventral joint complementing PFD turning due to ballast(s) at other locations. Furthermore, when sleeve means 92b is sewn onto the oversized foam layer 63b it further advances the transfer of the positional energy of the ballast into rotation of the PFD/victim reducing the amount of ballast required for reliable active self rescue.

PFD WITH ATTACHED COMBINED BALLAST AND SIGNALING PARTS LIST (FIGURES 20 through 38)

1b Combined ballast and signaling means

2b Continuous or stroboscopic illuminating means

3b Wearer operable appliance switch

4b Elongated battery containment means

5b Locking attachment means for securing ballasted signaling device

6b PFD wearer

7b Yoke Collar Style PFD

8b Cervical Side Joint stiffener

9b Cervical joint strap and stiffener for non-ballasted side

10b Light source

11b Additional ballasting batteries

12b Thickened high-density wall of container

13b Variably Sized High density plug

14b High density water excluding packing medium

15b O-Ring sealed threaded connector

16b Secure attachment means

17b O-Ring Sealed Switch

20b Vest Style PFD

21b Mobile ballast battery container means

22b Single attachment point

23b Conductive cable connecting ballasting batteries to appliance

24b Additional parallel ballasting batteries

25b Signaling Device

30b Cephalic Cradle portion of second buoyant means

31b Dual securing straps for cephalo-cervical buoyant cradle

32b Cervical cradle portion of second buoyant means

33b Cephalo-Cervical Cradle

34b Asymmetric ventral buoyant means

35b Dual securing means for ventral buoyant means

36b Thermal protective inner liner for two part PFD

37b Dual arm mobile ballast battery means

38b Ballasting battery units

39b Right arm attachment point

40b Appliance

41b Crotch strap

42b Secure Fastener Means

50b Existing foam components for Yoke Collar Style PFD

51b Cervical foam component of a traditional Yoke Collar Style PFD

52b Ventral foam component of Yoke Collar Style PFD

53b Alternate configuration for foam layer showing Single Posterior-Cervical Joint

54b Alternate foam layer configuration showing two piece layer with Single Side Cervical Joint

55b Alternate Single Piece layer combining cervical and ventral components

56b Over sized single piece base foam layer

57b Regular sized single piece foam layer

60b Combined Internal Ballast Component and lateral Stiffener

61b Ventral Coated Fabric Cover

62b Dorsal Coated Fabric Cover

63b Binding Tape

64b Combined Ballast and Appliance Fastener means

65b Anterior Stiffener

70b Amplified Cervical Displacement means

71b Relatively reduced ventral displacement means

72b Ballast attachment side, PFD Foam Layer Compressing chest strap

73b Alternate side PFD Foam Layer Compressing chest strap

74b Chest strap retainer guide

80b Rigid Swing Arm of mobile ballast

81b 90 degree Range of Motion Stop
82b Internal Ballast Plate
83b Tubular liner guide
84b Ballast Attachment cover
85b Locking Attachment means for mobile swing ballast and lever arm
86b Quick Release attachment means for ballast
87b Ballast means
88b Inner Locking Jaw
90b Buoyant arm of device
91b Hinge Pivot means of appliance
92b Sleeve means integrated into PFD
93b Hinge pin means
94b Hinge pin retainer means
95b Reduced Volume Buoyant Arm
96b Die cut sewable plastic sleeve means
100b Enhanced non-ballasted ventral component
101b Relatively diminished ballasted ventral component

Some of the advantages achieved with and/or features of one or more of the embodiments illustrated in Figures 72 through 90 include the following: (1) Combined Rotational and Functional Ballast attached to Life Jacket; (2) Ballast that is comprised in total or part by power supply means; (3) Ballast that is comprised in total or part by signaling, illumination or appliance means; (4) Ballast that is comprised in total or in part by containment means; (5) Ballast that is comprised in total or in part by high density component to offset buoyant functional components; (6) Ballast that is comprised in total or in part by neutral or negative packing fluid/gel; (7) Ballast that is comprised in total or in part by high density stiffener/attachment means complementing functional ballast means; (8) Fixed

midline functional ballast/power supply/appliance; (9) Fixed eccentric functional ballast/power supply/appliance; (10) Mobile midline functional ballast/power supply/appliance; (11) Mobile eccentric functional ballast/power supply/appliance; (12) Dual Arm Mobile functional ballast/power supply/appliance; (13) Ballast power supply connected to remote appliance; (14) Attached buoyant device eccentric; (15) Attached buoyant device midline; (16) Eccentric shaped midline buoyant means; (17) Independent cephalo-cervical buoyant cradle means; (18) Buoyant thermally protective inner shell of PFD; (19) Rigid arm attachment means for mobile eccentric functional ballast/power supply/appliance; (20) Interchangeable variable rigid arm length of attachment means for mobile eccentric functional ballast/power supply/appliance; (21) Flexible arm attachment means for mobile eccentric functional ballast/power supply/appliance; (22) Neutrally buoyant ballast and foam means attached at opposite sides to PFD; (23) Placement of ballast offsetting foam in ventral leg opposite of site of ballast attachment; (24) Reduced single sided lateral cervical joints, through foam layer design(selection, construction); (25) Reduced bilateral cervical joints, through foam layer design; (26) Eliminates single sided lateral cervical joints, through foam layer design; (27) Eliminates bilateral cervical joints, through foam layer design; (28) Oversized foam base layer sewn into fabric shell of life jacket; (29) Oversized foam top layer sewn into fabric shell of life jacket; (30) Alternating incomplete foam layers increasing cervical displacement relative to ventral displacement; (31) Alternating incomplete foam layers increasing the buoyant lateral ventral displacement relative to the opposite ballasted

ventral side; (32) Alternating incomplete foam layers increasing both cervical displacement means relative to ventral and increasing the buoyant lateral ventral displacement relative to the opposite ballasted ventral side; (33) PFD of solid foam construction with eccentric displacement means; (34) PFD of solid foam construction with left right ventral components of unequal displacement means; (35) PFD of solid foam construction with cervical and ventral components of unequal thickness of displacement means; (36) PFD of solid foam construction with eccentric displacement means where side with attachment means for ballast or combined ballast and appliance device is reduced relative to the opposite ventral means; (37) PFD of solid foam construction with eccentric displacement means where side with attachment means for ballast or combined ballast and appliance device is reduced relative to width and or thickness and or length of the opposite ventral means; (38) PFD of solid foam construction with eccentric displacement means where side with attachment means for ballast or combined ballast and appliance device is reduced relative to wedge shaped opposite ventral buoyant means; (39) Ballast sided foam layer compressing strap means; (40) Bilateral foam layer compressing strap means; (41) Rigid swing arm with stop; (42) Rigid swing arm supported by tubular hinge; (43) Rigid swing arm with attached ballast component; (44) Fabric encased ballast plate; (45) Tubular fabric webbing encased ballast plate/framework; (46) Dual eye ballast attachment points for attaching ballasted signal device; (47) Stiffener attached to swing arm hinge; (48) Rigid swing arm with stop attached to inherent buoyant means; (49) Wearer operable ballasting appliance attached to rigid swing arm with stop; (50) Water activated ballasting appliance

attached to rigid swing arm with stop; (51) Appliance housing with Horizontal mounting means; (52) Appliance housing with Horizontal mounting means paralleling illumination means; (53) Appliance housing with Horizontal mounting means paralleling signaling means; (54) Appliance housing with Horizontal mounting means paralleling appliance means; (55) Mounting means of Ballasted signaling device separating housing into buoyant and ballasting sections; (56) Mounting means of Ballasted signaling device separating housing into short buoyant and long ballasting sections; (57) Container means of combined ballast and signaling device with reduced buoyant illumination component of short buoyant arm that stops against the anterior face of PFD; (58) Container means of combined ballast and signaling device with enhanced ballast at extreme end of long ballast arm that stops at the greatest distance from the PFD axis of rotation; (59) Pivot means dividing combined ballast and signaling device into buoyant anterior stop arm and ballasted rigid posterior swing arm; (60) Dual position ballasted signaling device, ballast lateral in prone position; (61) Dual position ballasted signaling device, ballast medial in supine position; (62) Buoyant signaling means forward of pivot means; (63) Buoyant signaling means forward of pivot means adapted to lie parallel to anterior face of PFD in active position; (64) Buoyant signaling means forward of pivot means adapted to extend perpendicular to PFD in face up position and lie along anterior face of PFD in ballast active face down position; (65) Dedicated ballast and Power located ballast posterior of pivot means; (66) Sewable plastic sleeve hinge component means; (67) Die cut sewable single piece hinge component; (68) PFD with integrated hinge means; (69) PFD with plastic sewn in hinge

means; (70) PFD with multiple standardized hinge components; (71) PFD with ventral cervical hinge component with hinge pin; (72) PFD with ventral cervical hinge component with rigid hinge pin; (73) PFD with ventral cervical hinge component with semi-rigid hinge pin; (74) PFD with ventral cervical hinge component with hinge pin with combined ballast and appliance device; (75) Illumination or appliance strap means that splints one or both lateral cervical joints; (76) Stiffener means externally applied that splints one or both lateral cervical joints; (77) Stiffener means integrated during construction that splints one or both lateral cervical joints; (78) Attachment means stiffener on both lateral and anterior sides; (79) Lateral attachment means stiffener constructed of high density material; (80) Anterior attachment means stiffener constructed of low density material; and (81) Non Inflatable PFD constructed of coated fabric.

Figures 39 through 65 illustrate further embodiments for ballast personal flotation devices and related accessories.

The anterior buoyant means 1c and the ventral inferior buoyant means 2c shifts the PFD center of buoyant down and anyway from the axis of rotation of the victim. This supplies the raw torque required to roll a flaccid diver. The anterior and lateral buoyant means has vectors that are not in line with the any structural members of the PFD, consequently the buoyant force of the anterior member rises straight up but through its attachment to the PFD and victim rocks the victim back. At the same time the posterior and superior positioning of the directed mobile ballast 3c shifts the center of gravity up and back. Under the force of gravity the ballast means pulls the victim back. This

diametric positioning of the centers of gravity and centers of buoyancy creates a new corrective turning action heretofore unassessed during the testing and approval process. By moving the ballast and buoyant forces a greater distance from the axis of rotation you optimize the torque generated per unit mass or displacement. For a jacket of the same amount of displacement the foam means can be relocated into a triangular bell bottom shape, see figure 40. From the frontal view the lateral extensions can be visualized as diagrammatically outlined in Figure 42. At the lateral edge of the anterior buoyant means the vertical arm 43c of the buoyant force is unopposed and attempts to rise. The kinetic energy pivots about point 40c converting into a circular motion 42c. This is synergistically complemented by the solid ballast moving within the container 3c creating rotary motion 41c also about pivot point 40c. The ballast moment either fluid 31c, fluid 31c and solid 5c, or just solid, the fluid level 4c can interface with either a gas such as air or a collapsed space such as 34c. As the victim falls face first into the water the fluid 31c ballast relocates under the influence of gravity from the posterior position into an eccentric outboard lateral anterior position where it shifts the center of gravity 41c, freeing the ventral buoyant means to complete the corrective turning action. The fabric container can be either single wall as in 51c or double wall as in 161c. In figure 54, the double wall construction with inner bladder 160c and outer fabric layer 161c allows the shifting fluid ballast 31c to be more accurately shaped and directed. The fluid ballast easily traverses surface irregularities 163c and allows rapid smooth transition from inactive to active. Notably, where the fluid is water based, it converts from a source of ballast when held aloft in the

air behind the victim's head, to become neutral as the victim rolls from face down to face up.

In figure 48 mobile buoyancy 100c turns about pivot point 101c shifting the center of buoyancy resulting in an imbalance contributing to the rotary motion 42c. In figure 57 the apex of inferior triangular buoyant member can be capped by a harder material 192c that pivots upon a stiff plate 193c. The fabric shell 195c forms a hinge 194c connecting the mobile inferior buoyant means with the shortened main ventral buoyant means 196c. The mobility of the inferior buoyant means is enhanced by an inferior chest strap 191c that is attached at both sides by arm piece 190c. While the strap 191c can be tightened about the victim 18c, the arm 190c leaves in a degree of mobility that allows the lateral components to shift to the left or right supplying the initiating moment without which turning does not occur. The upper ventral means 196c are held tight against the chest by overriding chest strap means 17c. The use of an adjustable collar with side entrance 197c prevents the head and neck from being driven between the ventral arms where it shifts the distribution of ballast creating a stable face down position.

All current inflatable PFDs fail during face first entry because the ballast of the victim's head drives the neck between the ventral buoyant members into a stable airway submerged position. In figure 43 the inflatable PFD discloses overlapping tongue 59c that bridges the neck opening so that the neck cannot slide out of position. A superior baffle welded into the PFD also creates a mandibular shelf supporting the flaccid head and neck. Vertical baffles 52c covered by a fabric lock are compressed upon inflation further blocking the neck from sliding

between the ventral arms on unconscious entry. With a double walled PFD shown in figure 55, the inner air bladder 170c is shaped by the sewn outer cover 171c. This construction method allows creation of very specific shapes and faces 172c for mounting fabric locks to automatically secure closure upon inflation. The pneumatic compression lock is a critical complement to the automatic inflation mechanism that actuates upon immersion. While mechanical ties are an alternative the pneumatic lock occurs without requiring any participation by the wearer. The inner bladder is held in place by perimeter attachment means 173c. The fluid ballast and fabric container 174c complements the soft storage of the inflatable PFD. The fabric container also allows very specific relocation of narrow diameter posterior container components 175c and upon active distribution the diameter increase consolidating the ballast 176c into a more active condensed mass. An alternative pneumatic fabric collar lock can be achieved by mounting the fabric lock on the external fabric cover. When the inflatable chamber opens upon detonation of the compressed gas cylinder, the bladder expands and rips open the outer cover. The hook and loop on complementary sides meets in the middle where continued expansion by the inner bladder compresses the lock together. The inflatable is promoted because of its convenient deflated profile, only fluid ballast in a fabric container can be transparently stored within the low profile cover.

Some current inherently buoyant PFD designs require the concussive effect of solid mobile ballast. As seen in figure 56, the specific cervical collar angle determines the horizontal plane angle 184c when floating face down. The planar surface 180c of the ballast container 3c allows rigid ballast 181c to move quickly and freely in response to

whatever lead is demonstrated by the victim. In the face up position mobile ballast trap 120c fixes the ballast midline where it stabilizes the victim as a keel.

Mobile ballasts either fluid 31c or solid 181c or combined benefits from concurrent fixed midline ballast 19c. Integration of mounting means 36c at the most beneficial posterior superior position assures that any attached ballast contribute to airway protection rather than opposing the jackets efforts at corrective turning action.

Once the victim survives the initial shock of entry they must focus on rapidly removing themselves from the water to avoid hypothermia. As seen in Figure 58, a windsock 200c gathers the wind, with sufficient wind velocity such that it will blow through the flapper valve 203c. If the wind is not strong enough to open the flapper valve 203c then the windsock is used to scoop up the air and the opening is closed by one hand while the other hand slides down the windsock transferring the air through a one way valve 203c into the raft. As the pressure mounts in the first chamber a medium pressure valve 209c opens into the adjacent raft tube in the bulkhead allowing air to fill both portions of the raft's perimeter tube. A wrist lanyard 214c helps the user keep hold of the raft in heavy winds. A body lanyard 212c attached at a reinforced seam grommet 211c provides a backup means for securing the raft to the victim in case the raft is kiting.

Once the raft is inflated, the attached locking nut 207c is loosen, freeing the reinforced windsock gasket seal 206c and thus the windsock is now removed. Now the attached locking caps means 204c can cover the opening against passive air loss or water entry. At this point the windsock can be used as a sea ballast container means 216c, where the

attachment lanyards 217c are used to connect the sea ballast container to the raft at the reinforced perimeter. The sea ballast fill tube 201c allows the sea ballast container to be completely filled from inside the raft and the sealed with closure means 202c.

In figure 60 the windsock acts a valise 220c for the raft 223c allowing it to be attached to the PFD serving as a cummerbund 222. Backpack straps 224 allow the valise to be transported separately.

Figure 61 adapts the windsock 200c into a funnel 230c to collect and contain rain. The inclusion of a clear plastic cover 233c converts the windsock 200c into a solar still 231c. The clear cover can be sealed by fabric lock 232c. The clear cover can be held aloft by rigid supports 234c. The sun strikes a source of water 235c which is evaporated and then condenses 236c on the windsock where it collects within the base of the windsock or ideally in an external container 238c. The windsock inflator 200c can be further adapted for use as a sea anchor windsock 240c as seen in figure 62. The wrist lanyards 214c that encircle the perimeter of the opening windsock opening are now attachment points for lines leading to the sea anchor spreading ring 241c. The lines after crossing the sea anchor spreading ring converge into a single line that runs forward to the rear of the raft 242c. The sea anchor scoops up the water and forces it through the windsock vent. This drag determines the rear of the boat and keeps the boat pointed in the same direction in mounting seas.

As seen in Figure 63, the mobile eccentric fluid ballast that shifts location as the child falls face forward results in the shift of the center of gravity the initiates the escape of the ventral buoyant means. When the mobile

eccentric ballast container is clear 251c it allows the child to observe the brightly colored water 254c slosh back and forth. Mixing oil and water further increases the dramatic effect and the inclusion of two or more colored fluids. Given the very serious problem of willing compliance with wearing jackets the inclusion of brightly colored objects such as sea creatures or favorite cartoon characters may result in the jacket being worn home from the boat and to school as would be a welcome relief to the struggles traditional associated with wearing life jackets, which is currently not required by law in numerous states. A small pond of fish on their shoulder helps to localize the ballast thereby increasing its impact on corrective turning as is needed with vest style designs. The child's vest as well as the adults in addition benefits from the above disclosed PFD embodiments in combination with mobile eccentric fluid ballast in order to achieve reliable airway protection.

It should be recognized that an alternative pneumatic compression lock for inflatable PFDs can also be provided and is within the scope of the invention. Some inflatable PFDs are stowed with an external fabric cover that separates upon detonation of the compressed gas inflation means. If the complementary fabric lock means were distributed on the opposite sides of the external cover, upon inflation as the cover is peeled back they brush against each other along the midline. If the hook and loop connect then as the volume first increase then the pressure builds the right and left halves of the front of the jacket compress the lock securely together. This lock is sufficient to prevent the ballast of the head from driving the neck down between the left and right buoyant means. If the neck does slide down, the victim ends up in a stable face down position if the pneumatic

compression lock securely closes the vest then the inflatable PFD effects a strong righting moment because of its predominance of displacement and other than face first entry of an unconscious victim, good control of ballast of the head and neck.

The adjustable collar can be provided with either a certain degree of laxity in the outer fabric cover or a stretchable element interposed along the top and sides of the cover so that as the ventral arms are separated to allow entrance of the head and neck the overlapping layers of the cervical collar to extend temporarily beyond the perimeter. After the neck is in position and the ventral arms returned to their central position, the cervical collar perimeter is restored to its minimal footprint.

Some advantages and features of this alternative pneumatic compression lock include, but are not limited to: (1) fabric lock mounted on external cover while compression is supplied by the inflating inner bladder; and (2) stretchable element built into the fabric cover of the cervical collar to allow transient expansion when the jacket is being donned.

As seen in Figure 64, the use of a square container allows the shape of the fluid ballast to minimize the reduction in foam displacement. While the container can be made from rigid plastic ideally the container can be carved right out of the body of the cervical collar 260c. The flexible over sized fabric inner layer 261c conforms to the shape of the outer container. The use of a shallow container 263c along the posterior superior aspect of the collar allows the fluid to layer out below the water surface thereby neutralizing the ballast when floating face up. In this position the contained liquid acts as a sea ballast

stabilizing the face up position. The gas in the container rise to the highest point available 262c. The lateral anterior extension of the rigid container can be enlarged 268c to hold more of the fluid ballast as far outboard complementing ballast shifted into the inferior lateral extension 269c. The combined shift from midline to lateral edge strongly initiates the corrective turning action moment. An additional mobile fluid ballast container can be located along the lateral posterior ventral buoyant means 270c.

Figure 65 is a posterior view of the inflatable dive jacket or buoyancy compensator 271c attached to a diver's air cylinder 276c by means of a tank band 277c. The dive jacket has been constructed to include a posterior 274c and lateral 272c locations for mounting a fluid ballast container. The lateral filling valve 273c and the posterior filling valve 275c allow independent function or can be combined into a single mobile eccentric fluid ballast container. The valve allows the ballast to be left at the sea shore after the end of the dive. The level of the fluid 278c within the fluid ballast container demonstrates residual air 279c above the mobile ballast this creates the space that allows the ballast to shift positions.

Certain advantages and/or features of the embodiment shown in Figures 64 and 65 include, but are not limited to: (1) Space defined by foam buoyant means to house mobile fluid ballast container; (2) Space defined by foam buoyant means to shape mobile fluid ballast container; (3) Space defined by foam buoyant means to direct mobile fluid ballast container; (4) Space defined by foam buoyant means to house, shape and direct mobile fluid ballast container; (5) Space defined by inflatable buoyant means to house mobile fluid

ballast container; (6) Superior mobile fluid ballast; (7) Lateral fluid ballast; (8) Lateral mobile fluid ballast; (9) Superior and lateral mobile fluid ballast; (10) Sealed container for mobile fluid ballast; (11) Container for mobile fluid ballast with valve to fill before use drain after use; (12) Inflatable PFD modified with means to contain fluid ballast; (13) Inflatable PFD modified with means to contain mobile fluid ballast; and (14) Inflatable PFD modified with means to contain eccentric mobile fluid ballast.

Parts List (Figures 39 through 65)

1c Anterior Buoyant Element

2c Ventral Inferior Buoyant Element

3c Posterior Superior Container for Directed Mobile Ballast means

4c Mobile Air Fluid Level

5c Combined High Density Directed Mobile Ballast and liquid ballast means

6c Cap to contain mobile ballast elements

7c Buoyant Means 30 degree Head Angle Wedge

8c Adjustable circumference buoyant collar layers

9c Cervical-Ventral Structurally continuous Foam Means

10c Cervical Foam Structural Tie - Hinge Means

11c Mandibular Shelf Inferior and Lateral Bracket

12c Anterior Cervical Splash Gutter

13c Oral-Nasal Splash Diverter

14c Stiff Hinge Diverter Arm means

15c Reverse Cant Leading Wave Break

16c Guide Notch locating Chest Strap Fulcrum

17c Chest Strap

18c PFD User/victim

19c External combined midline fixed ballast and signaling device

20c Apical extension of pyramidal anterior buoyant means

21c Lateral Extensions of Inferior and Anterior Buoyant Elements

22c Adjustable Sized Cervical Collar

23c Strap Securing Means for Adjustable Collar

24c Quick Release Buckle

25c Variable Length Chest Strap

26c Abutted Ventral and Cervical Joint in the vertical position

27c Oral Nasal splash cover

28c Moldable nasal bridge edge

29c Complementary attachment means for oral nasal splash cover and collar closure means

30c Flexible Liquid Ballast container

31c Submerged, potable, dyed, signaling liquid ballast means

32c Liquid level

33c Water's surface

34c Collapsed fabric container creating potential space means for alternate location of liquid ballast

35c Liquid ballast flexible container's perimeter attachment means establishing liquid ballast's course posterior midline to lateral

36c Combined Vent and locator means for combined ballast and signaling device

37c Coated fabric weld line

40c Frontal Plane Pivot Point

41c Direction of mobile ballast's contribution to frontal plane turning

42c Direction of Ventral Buoyant means escape

43c Unopposed vector component of inferior lateral and anterior buoyant means

44c Vector component acting at apex of inferior lateral and anterior buoyant means

50c Welded horizontal baffle Mandibular Shelf

51c Flexible integrated fluid ballast means

52c Right welded baffle face allowing flush mounting of complementary interlocking closure means

53c Excess weldable fabric welded or sewn to secure closure mounting means

54c Alternative flexible mounting means for automatic secured neck closure and oral-nasal splash diverter

55c Combined battery and fixed midline ballast

56c Locator grommet for attaching fixed ballast

57c Signaling device

58c Compressed air inflation means

59c Protruding and overlapping inflatable neck closure means

60c Anterior Right overlapping collar layer

61c Anterior Left stop for pivoting right collar and source of displacement

62c Posterior Right overlapping collar layer

64c Frontal plane pivot point

65c Anterior Left overlapping adjustable collar layer

66c Cam flare allowing selection of neck circumference

67c Void between pivoting posterior cervical collar and Stop means to allow for rotation

70c Foam displacement offset for mobile ballast to achieve neutrality or positive buoyancy

71c Strap means for securing retrofit container mobile eccentric ballast to PFD

72c Interlocking securing means for attachment strap

80c Rectangular opening along middle position of mobile ballast container

81c Perpendicular Rectangular cut at midline

83c Flared quadrant forming ballast trap

90c Midline fixed ballast means

91c Secure attachment means for fixed ballast

92c Open mesh vent and attachment means

93c Permanent attachment means for mesh

94c Secure reversible closure means

100c Mobile buoyant means

101c Flexible arm hinge means for mobile buoyant member

102c Continuation of base layer behind mobile buoyant member

103c Opposite lateral fixed or mobile buoyant extension

104c Gravity filled anterior-inferior aspect of flexible or rigid ballast container

110c Retainer Means for open or closed container means integrated into or added onto PFD collar.

111c Rigid Convexity Form

112c Flexible Buoyant Means Conformed to Rigid container

113c Bilateral Steep vertical wall of midline ballast trap

114c Smooth Inferior Sloping wall

115c Small fill opening in ballast container

116c Semi closed cap and ballast stop

117c Sea Water Anchor combined with mobile ballast container means

118c Sealable Container integrated into mobile ballast injection molded container for midline fixed combined battery-ballast means

119c Fixed midline ballast-battery means

120c Trap for solid mobile ballast means

121c Left overlapping inflatable midline lock

122c Right overlapping inflatable midline lock

123c Inflatable oral nasal splash diverters

130c Breathable water resistant fabric oral nasal cover means

131c Oral nasal flap folded into cervical gutter

132c Open mesh vent means

133c Vertical Moldable stiffeners means

134c Permanent Fastening Means

135c Ocular cover means

136c Flexible clear view port means

137c Cranial edge moldable stiffener means

140c Hinge means to ventral buoyant member

141c Anterior Inferior Buoyant means active position

142c Anterior Inferior Buoyant means stored position

143c Anterior Inferior Buoyant member hinge means

144c Quick release buckle for chest strap

145c One side of fabric lock for anterior inferior buoyant member in storage position

147c One side of fabric lock for anterior inferior buoyant member in active position

148c Handle of collar closure strap

149c One side of fabric lock for collar closure strap

150c Structurally continuous base layer

151c Lower cervical and ventral buoyant layers

152c Posterior cervical layers

153c Complementary curve in superior cervical layers allowing for rotation about center of neck opening

154c Complementary curve in inferior cervical layers allowing for rotation about center of neck opening

155c Void between superior and inferior cervical layers allowing for rotation and for individualized variation of PFD neck diameter

160c Flexible oversized inner welded bladder

161c External fabric perimeter constraining inner bladder

162c Welded closure means of fluid containing inner bladder

163c Excess inner bladder material allowing external fabric to bear strain and direct fluid

170c Over sized gas containing bladder means

171c Size restricting external fabric shell determining final shape and bearing pressure from inner bladder

172c Unusual faces and planes unobtainable with planar welded fabric and simple baffles

173c Perimeter attachment means

174c Single or double walled fluid ballast container means welded to inner bladder or sewn to outer bladder

175c Narrow diameter superior container

176c Large diameter anterior and inferior extension of bladder means

170c Over sized gas containing bladder means

171c Size restricting external fabric shell determining final shape and bearing pressure from inner bladder

172c Unusual faces and planes unobtainable with planar welded fabric and simple baffles

173c Perimeter attachment means

174c Single or double walled fluid ballast container means welded to inner bladder or sewn to outer bladder

175c Narrow diameter superior container

176c Large diameter anterior and inferior extension of bladder means

180c Planar platform for solid ballast parallel to water's surface

181c Solid ballast means in air filled buoyant enclosed container

182c Container for mobile ballast set at angle specific to the angle of the posterior cervical collar off of vertical

183c Vertical

184c Complementary angle of posterior foam establishing a structural surface parallel to the waters surface for mobile ballast element

190c Buoyant arm means

191c Inferior chest strap attached at lateral perimeter of mobile buoyant means

192c Hard plate cover to foam apex

193c Hard plate cover of inferior aspect of ventral foam member

194c Fabric hinge attaching mobile to fixed buoyant members

195c Fabric cover enclosing buoyant members

196c Shortened fixed ventral buoyant means

197c Lateral neck opening

198c Neck opening closure strap means

199c Lock closure means for neck strap

200c Wind sock inflator

201c Fill Tube for sea ballast means

202c Fill Tube Closure means

203c Low pressure one way flapper valve means

204c Attached locking cap means

205c Air seal gasket means

206c Reinforced wind sock gasket seal

207c Attached locking nut

208c Windsock vent closure means for conversion to sea ballast

209c Low pressure one way check valve between raft chambers

210c Inflatable floor

211c Reinforced seam attachment grommet for lanyard

212c Quick release body or sea anchor lanyard

213c Windsock opening closure means

214c Wrist or sea anchor or sea ballast lanyards

215c Very Low pressure one way check valve to raft floor

216c Sea Ballast windsock container means

217c Sea ballast reinforced attachment lanyards

218c Sea ballast fluid level

219c Sea level

220c Life Raft Valise

221c Valise securing means

222c PFD Life Raft Cummerbund means

223c Stowed PFD Life Raft

224c Valise Back Pack Straps

230c Windsock adapted to function as funnel to capture and or contain solar condensate or clean rain water

231c Solar still funnel collecting condensate for solar evaporation

232c Fabric lock sealing clear cover to dark funnel

233c Clear cover of solar collector

234c Rigid supports for clear cover

235c Source of liquid for solar collector to generate condensation

236c Condensate

237c Collected condensate if no container is available

238c Condensate collection container

240c Sea Anchor windsock

241c Sea anchor spreader ring

242c Rear portion of Raft

250c Child's vest life jacket

251c Clear mobile eccentric ballast container

252c Brightly colored sea creatures

253c Enlarged active container means

254c Colored fluid

260c Carved foam mobile eccentric fluid ballast container

261c Flexible over sized inner sealed liner

262c Gas risen to highest point

263c Shallow rectangle keeps fluid ballast at or below water surface

264c Fluid level within inner liner

265c Water's surface

266c Fabric extension fill tube

267c Welded seal after filling with fluid

268c Enlarged lateral component of fluid ballast container

269c Inferior lateral extension for eccentric mobile fluid ballast

270c Perimeter eccentric fluid ballast along ventral buoyant means

271c Inflatable Dive Jacket or buoyancy Compensator

272c Lateral Perimeter liquid ballast

273c Valve for filling or draining

274c Posterior cervical mobile eccentric fluid ballast container

275c Posterior cervical mobile eccentric fluid ballast container valve for draining or filling fluid ballast

276c Diver's air cylinder

277c Dive Jacket tank band

278c Fluid gas level in mobile ballast container

279c Gas means in mobile eccentric fluid ballast

Some of the advantages and/or features of one or more of the embodiments shown in Figures 39 through 65, include, but are not limited to, the following: (1) Center of buoyancy shifted inferior and anterior; (2) Pyramidal shaped buoyant means with increased lever arm to axises of rotation; (3) Increased lateral buoyant means; (4) Increased

anterior buoyant means; (5) Increased inferior buoyant means; (6) Decreased central medial buoyant means; (7) Flexible arm connecting distant buoyant and ballast means; (8) Marked flexibility in the posterior direction; (9) Flexibility bilaterally restricted by type of foam and width of the connection of the apex to the cervical collar; (10) Anterior flexibility blocked by the abutted walls of the apex and collar bodies; (11) Apical attachment point of inferior buoyant arm and superior ballast arm located adjacent the centroid of buoyancy for the wearer and their life jacket; (12) Foam or inflatable buoyant means; (13) Life jacket turning torque amplified by shifting the PFDs center of buoyancy and center of ballast maximum allowed distance from the axises of rotation by reconfiguring the structure; (14) Continuous base layer integrating effect of displaced inferio-anterio-lateral buoyant means with posterior superior displaced ballast means; (15) Variable diameter neck opening; (16) Two or more overlapping cam shaped collar layers; (17) Superior and or inferior foam surfaces bilaterally notched with three-dimensional mandibular shelf variably positioned to bracket and splint the jaw; (18) Closure means to secure collar entry / exit; (19) Locking closure means; (20) Enhanced bilateral inferior displacement means; (21) Gas and Liquid ballasting means; (22) Flexible container means directing flow of liquid ballast; (23) Broad posterior and superior container means located at or beneath the water's surface to center and neutralize the fluid ballast; (24) Inferior anterior extension of container means liquid filled when upright or face down, gas filled when floating face up on the water

Flexible container for liquid ballast sewn along superior and lateral fabric cover; (25) Flexible container for liquid ballast constructed of puncture proof ballistic fabric; (26) Flexible container for liquid ballast with over pressure valve; (27) Flexible weldable expandable fabric to tolerate freezing expansion; (28) Unsupported stretchable weldable fabric container for liquid ballast; (29) Rigid container means of same shape keeping the liquid centered and below the water when face up directing the fluid down and outboard when upright; (30) Liquid and Solid ballasting means; (31) High-density spherical mobile ballast means combined with fluid means; (32) Liquid, solid and gas ballasting means; (33) Combination of gas liquid and solid ballasting means; (34) Center trap in container means to convert the solid mobile ballast into fixed midline position; (35) Open rigid container for solid ballast means restricted for filling or emptying that convert container into a transient combined solid and fluid anchoring and ballasting means; (36) Offsetting buoyant covering of open rigid solid and fluid ballast container; (37) Liquid Sterile for consumption; (38) Liquid combined with potable food coloring to detect loss of ballast; (39) Liquid Search and Rescue Orange dye for signaling aerial rescue efforts from Life Raft; (40) Liquid chemically with lowered freezing point; (41) Potable liquid chemically with lowered freezing point; (42) Dyed, potable liquid with lowered freezing point; (43) Mobile buoyant means; (44) Eccentric mobile buoyant means; (45) Symmetric mobile buoyant means; (46) Laterally mobile buoyant means; (47) Anteriorly buoyant means; (48) Foam or inflatable; (49) Reverse face in the inferior end of the ventral arms redirecting wave away from victim; (50) One of more side to side oral nasal splash diverter; (51) Partially flexible arm

connecting splash diverter elevating operational height; (52) Cervical Trough splash receiver; (53) Optional cover flap to cover nose and mouth; (54) Semi-rigid moldable nasal edge adjusted to shape of the bridge of the nose; (55) Securing means for attaching oral nasal cover flap; (56) Oral nasal cover flap water resistant breathable fabric-Gore-Tex™; (57) Oral nasal flap with open mesh off to sides to allow CO_2 to escape; (58) Oral nasal flap with stiffeners to support fabric means away from the face; (59) Oral nasal flap of stiff fabric to bridge facial features preventing occlusion; (60) Separate Ocular flap; (61) Ocular flap with moldable stiffener along superior and inferior edges; (62) Ocular flap of clear flexible means; (63) Combined Oral nasal ocular flap; (64) Combined Oral nasal ocular flap with moldable stiffeners along edge; (65) Combined Oral nasal ocular flap with moldable stiffeners along edge and through out the field; (66) Anterior inferior buoyant means attached via hinge means; (67) Dual position inferior anterior buoyant means positioned beneath ventral arm for stowage or for entry into life raft; (68) Active position of inferior anterior buoyant means attached to front face of PFD ventral arms; (69) Side entrance collar with over lapping layers for adjustability; (70) Dual bag PFD with oversized inner airtight chamber contained within sewn fabric cover to allow creation of three-dimensional shapes required to create effective inflatable lock; (71) Fluid ballast container welded to bladder of inflatable PFD; (72) Fluid ballast container of enlarged diameter in forward anterior extension consolidating water ballast in active position; (73) Fluid ballast container of reduced diameter in the posterior superior extension distributing water ballast in resting position; (74) Container for mobile eccentric solid ballast

with planar base parallel to water's surface; (75) Container for mobile eccentric solid ballast with non-directing linear leading edge; (76) Inferior plane of mobile ballast container mounted upon cervical foam of angle complementary to the angle of the foam to the water's surface; (77) Inferior chest strap suspending mobile buoyant means; (78) Inferior chest strap suspending mobile buoyant member from perimeter of buoyant member by arms of a length to allow mobility sufficient for escape; (79) Inferior buoyant member with rigid cap of apex riding on rigid base of superior buoyant member; (80) Fabric hinge at apex attaches inferior and superior buoyant members allowing for movement about hinge; (81) Manual Pneumatic compression lock; (82) Automatic pneumatic compression lock; (83) Fabric cover connecting welded seams mounting opposing interlocking means; (84) One or more baffles along cervical end of ventral arms; (85) Flat faced baffles covered in interlocking securing means; (86) Protruding inflatable means overlapping joint between ventral means; (87) Protruding inflatable means covered with pneumatically compressed interlocking means; (88) Superior baffle acting as mandibular shelf and splint; (89) Overlapping superior baffle acting as cover flap and mandibular shelf and splint; (90) Windsock structurally integrated into life raft; (91) Windsock structurally integrated into multiple structurally distinct buoyant chambers of raft; (92) Windsock reversibly attached to raft; (93) Sequential inflation via varied pressure relief fill valves; (94) Fill valves with optional lock caps; (95) Wind sock with attached wrist lanyard; (96) Wind Sock with attached body lanyard; (97) Wind sock with secure closure means to converting it into an Icelandic ballast means; (98) Wind sock with low strength fabric

between wind sock and raft air chamber protecting raft from excessive pressure from Icelandic ballast; (99) Wind sock with fill tube to top off Icelandic Ballast while in raft; (100) Wind Sock that can be detached from raft and attached via wrist lanyard to raft body lanyard and thereby act as steering sea anchor; (101) Wind sock that can be turned inside out to protect the raft in storage acting as the raft's valise; (102) Windsock modified with shoulder straps converting it into backpack for independent raft carriage; (103) Wind sock modified with attachment means to convert PFD's chest straps into a cummerbund; (104) Windsock modified with receptacles for paddle handle to use windsock as an air scoop for propelling raft; (105) Windsock modified to become the funnel and to seal clear solar collector for generating drinking water; (106) Windsock seal to collect and store rain water; (107) Clear mobile eccentric fluid ballast container; (108) Colored fluid as mobile ballast; (109) Bright colored objects bobbing in fluid confirming presence of fluid and that it is not frozen and as visual stimulus to small children; (110) Life Raft with integrated windsock inflator; (111) Life Raft with releasable wind sock inflator; (112) Life Raft with low strength tear fabric between wind sock inflator and raft tube; (113) One way valve between wind sock and one or more chambers of raft; (114) Locking caps on inflation valves; (115) One way over pressure valve between windsock and raft chambers; (116) Differential inflation of chambers by varying strength of opening pressures of one way valve; (117) Sea Ballast container made from windsock means; (118) Sea ballast container with fill tube to allow filling while in the raft; (119) Sea ballast lanyard attached around reinforced perimeter of windsock; (120) Windsock with wrist lanyard

attached at opening to prevent loss; (121) Wind sock with closure means; (122) Reinforced attachment of lanyard connecting raft to victim; (123) Sea Anchor created out of wind sock after raft is inflated; (124) Sea anchor connected by low strength fabric protecting raft tube from damage; (125) Life raft valise that functions as integrated inflator means; (126) Valise adapted to stow with cummerbund of PFD; (127) Valise with integrated shoulder straps for independent use; (128) Wind sock with dark interior coloration; (129) Windsock adapted to serve as solar still; and (130) Windsock adapted with fabric lock to seal clear cover.

The disclosed vertically eccentric Life Jacket strikes a new balance in the distribution of buoyancy and or ballast about the victim. The prevention of airway submersion is preferred to recovery of the victim after they become face down. Elimination of the danger Zone is the outcome of shifting the buoyant moment down and away and while the ballasted component is shift up and back relative to the PFD user. This separating of the centers of gravity and buoyancy in diametric opposed directions generates the greatest amount of torque per units of displacement and ballast. While buoyancy alone can create marked improvement in several characteristics of the PFD, the combination allows reduction in the amount of foam which helps reduce size easing storage and improving mobility and comfort.

Additionally, in the event of face first entry of an unconscious user, the ballast is very active, concussing the container walls, imparting the kinetic energy to initiate corrective turning action by freeing the opposite inferior anterior buoyant means which is concurrently seeking to escape. The concurrence of two active synergistic moments

markedly improves the frequency and rate of escape of the primary driving force to turning, the ventral buoyant means.

The bell bottom shape places the majority of buoyant means below the chest strap. The disclosed inverted design is exactly contrary to common knowledge and practice which advocates that buoyancy must be located high on the chest.

With the predominance ventral displacement means being located low it remains submerged, and therefore active, as compared to designs in which some of the foam is out of the water and their for inactive.

One main advantage of a rigid inverted V is all the force is trying to balance at one point. The entire force is precariously balanced through the triangular apex and is transmitted via a variably flexible member to the cervical component of the Life Jacket. Physically the lateral and anterior extensions at the base shift the buoyant moment in the opposite direction of the mobile ballast element located at the most superior posterior edge of the PFD. The lateral and anterior extension of the bell bottom base, when poised in the vertical Danger Zone, attempt to kick out to either side or to the front.

The base layer of foam runs continuously from the top of the cervical collar through to the base of the bell bottom ventral buoyant means. While alternate layers can bee glued do to the extreme flexure at the apex of the thorax, the entire adjustable cervical collar can be mechanically fastened at the angle of the jaw with something as simple as an upholstery bottom with heavy gauge nylon line or a broad based rivet of plastic or stainless. The top to bottom continuous base layer can be capable of marked flexing to the back, limited flexion side to side, and can be rigid preventing any flexion forward. This range of motion

accommodates several divergent uses required of the Life Jacket. For the conscious victim wishing to swim with their head up and back, the base layer flexes completely around the upper torso and down the chest by flaring open. This separates the variably sized buoyancy collar from the lower ventral means allowing the head to flex backward to facilitate swimming or scanning the horizon. A strictly rigid PFD opposes the extension of the neck. In the extreme one PFD unitizes a strut which is mechanically fastened to the back of the PFD that continuously presses against the back of the head. The wearer is unable to straighten their neck yet alone extend the neck into a comfortable swimming or viewing angle.

When the user is upright in the water column the flat face of the lower ventral unit can abut against the lower flat face of the cervical collar so that the force is directed straight up creating the greatest freeboard. If the user has been in the water long enough that their core temperature is dropping they are at risk of losing consciousness. With the angulation introduced into the vertically eccentric Life Jacket the user must immerse their face before they can position the center of gravity above the center of buoyancy. Since it is unlikely that the person will intentionally immerse their face they remain out of balance. That is the center of gravity is to the rear and the center of buoyancy is forward. As the user loses control of their legs, which are critically involved in maintaining their vertical position, the jacket slowly pulls them backwards keeping their airway out of the water the entire time. The mechanical shift of the buoyant means down low will reinforce whatever direction is initiated by the victim. If they lean left, the bell-bottom kicks right. If

they lean right, the buoyant means kicks left. In the center the anterior portion working with the rearward ballast simply pulls them back.

While numerous embodiments are obvious a continuous slope out from the front of the jacket while ascetically pleasing is more difficult to sew and stow. If the same amount of buoyancy is consolidated into the anterior inferior buoyant shelf it is simpler to build and a pair of jackets can stack in an overlapping fashion.

The Face First entry for the inherently buoyant, vertically eccentric, horizontally symmetric, Type A PFD consistently provides corrective turning action for several reasons. The adjustable collar with built in mandibular shelf brackets the jaw and holds the head erect. The collar encloses in front of the chin and securing means 23c secures the adjustable collar tightly about the neck.

Classically it was believed that the inflatable PFD because of it large size on inflation created huge displacements and therefore would always out perform the lower volume inherently buoyant PFD. The inflatable small size when deflated is a real advantage in assuring that the PFD is worn continuously so that it is on in the event of an emergency. PFDs are now approved that upon immersion activate the inflation device in an automatic fashion. Due to the design restriction of the inflatable PFD the cover is the source of attachment to the body. On detonation the cover is blown open and the PFD deploys around the neck. The pressure generated by inflated chamber is so tight around the neck that without restraint in design it can compress the neck to an alarming degree. The good side is that the collar firmly supports the head preventing it from flopping which is why the inflatable has such a good reputation at

turning. However in face first entry from a height as minimal as the edge of a pool the ballast of the head drives the neck as a wedge between the inflatable ventral arms. In this position the PFD floats most if not all testers face down every time. Applying the discoveries disclosed herein the inclusion of a baffle along both sides of the jacket below the neck provides two advantages. It creates a flat surface and by the selection of the size of the baffle can create a bulge that when covered by an interdigitating fabric lock creates a very secure closure.

The Posterior can turn around the apex because of the flexibility in the ventral cervical joint. It is now clear that the use of horizontally eccentric ballast or buoyancy while effective in contrived in line tests can be blocked if the individual falls off to the side. That corrective turning action must be able to occur to the right or left as directed by the vagaries of the victim and attached clothing. Thus the use of any fixed ballast is ideally located along the midline where it assists the completion of active self rescue from the 90 to 180 degree position. If the ballast of an illumination device is placed off to the side it will detract from the rate or possibly prevent corrective turning.

The separation of the centers of gravity and center of buoyancy generates the torque needed to roll the diver into an airway protected position. An overlapping posterior collar allows the adjustment for both entry and sizing. Individual specific sizing is critical because it keeps the individual secured to the jacket. In the event of loss of consciousness a marked flaccidity of the neck combines with wave action to work the victim out of the jacket, particularly a jacket with a fixed opening that must

accommodate a wide range of adult neck sizes. 50% of the fatalities of the Sleipner were found hanging beneath the PFD from the straps. The cover fabric of the adjustable posterior collar needs to be either very loose or ideally constructed of a flexible material such as spandex which accommodates the circumferential expansion necessary to first enter the jacket then adjust the size to the individual's neck.

The lateral superior aspect of the PFD collar is further modified to include left and right mandibular shelves. A reversible PFD requires mandibular shelves on both sides in order to preserve the reversibility of the jacket, a requirement of SOLAS PFDs. The disclosed mandibular shelf not only places a mandibular splint beneath the chin and jaw, but also places vertical walls along both the left and right sides of the jaw that prevents side to side droop of the head. It is the side to side droop that allows the ballast of the head to shift the center of gravity creating a cant to the face plane or worse creates a side high position allowing the airway to partially drop beneath the water's edge.

Both USCG and international standards require a head angle of 30 degrees with out which approval will not be granted. Thus between the overlapping posterior cervical layers can e inserted foam shims to mechanically adjust the collar to the correct angle. In a single sided PFD the shims can be located beneath the top layer. In a reversible PFD the shims can be placed in the center thereby elevating both sides equally. A sculpted depression in the posterior collar, while it detracts from the both freeboard elevation above the waters surface and head angle, it cradles the head and neck reducing the incidence of the head falling to one

side or the other. Once again when the head drop to the side it brings the mouth within dangerous proximity of the water's surface. Approximately 1" at the rear of the collar creates sufficient bevel to hold the head at the required angle to assist in the shedding of water off the face.

There are two broad categories of why a person would be unconscious in the water. First they enter the water unconscious or they become unconscious once in the water. Trauma is the most likely cause of entering the water unconscious, such as occurs when struck by the sail boats boom. Loss of body heat or hypothermia would be the leading cause of becoming unconscious after the victim has entered the water.

It has been proposed that PFD testing include an assessment of entering the water unconscious. The tester is to sit relaxed at the pool side breathing slowly then the tester is to fall face forward into the water with the arms, legs and neck limp. Such a simulation of unconscious entry is unexpectedly challenging to all existing PFDs whether high volume inflatable or low volume inherently buoyant. The present invention's use of contained mobile eccentric ballast creates repetitive concussive effects, as the ballast slams from side to side, end to end leading to a strong and rapid corrective turning action. Notably, the container is preferably big enough to allow kinetic energy to develop, which is imparted upon impact to the structure of the PFD. The rigid structure transfers this energy expeditiously to the ventral arms, which supply the majority of the power required to actually roll a flaccid person off their face, and onto their back. This test of high displacement inflatables, as well as the low volume inherently buoyant PFDs, is to challenging to pass.

Limiting the size of the mobile eccentric ballast's container is the need to keep the ballast away from the edge where it can impact the face plane by creating a dip to one side. This position lowers the corner of the mouth educing measured freeboard another pass fail criteria for USCG approval.

The individual that becomes unconscious once in the water secondary to hypothermia requires a different action from their PFD. While conscious the victim will be vigilant looking for fellow victims, passing ships, planes and hopefully one going rescue efforts. The best vantage point for observing then signaling help is vertical in the water column. The natural tendency is to balance on the PFD, which is achieved by legs hanging behind the jacket, arms in front, and head held straight up. In this position the center of gravity is directly above the center of buoyancy and the victim is balanced and therefore expending the least amount of energy. Any jacket that allows this positioning of the center of gravity directly above the center of buoyancy has a Danger Zone. That is defined as the vertical position that upon collapse allows the face to fall into the water. From this position 5-second corrective turning is required to prevent drowning, unfortunately a non-existent level of performance.

The present invention jacket through the use of ballast and buoyancy creates and axis through the thorax near where the PFD strap wraps around the chest. Placement of the ballast high for a reversible jacket and high and to the rear for a jacket that has a clearly identified front and optimally positions the ballast do that the conscious victim must place their face underwater in order to move their center of gravity far enough forward so that it can balance

upon the center of buoyancy. This is so unlikely that when they are vertical in the water column there is an ever-present effort of the vest to pull them backward. As the victim's core temperature drops and they loose the ability of the legs to adjust their position in space as they become obtunded, the jacket gentle pulls them backward away from the water, preventing submersion of the airway. This obviates the need for the jacket to quickly roll their face out of the water. Even if a jacket could roll an unconscious victim reliably there would be some associated aspiration. Thus, the present invention PFD is the first life jacket that does not have a Danger Zone.

Once the victim is unconscious and positioned on their back by the PFD the airway remains in need of continued protection from aspiration leading to drowning. Wave tank tests disclose that the victim turns into the waves and gradually drifts backwards. As the waves mount they lap at the butt of the PFD. The USCG Reference Vest is a very sleek design that slopes up towards the face. While this places the foam high on the chest it creates a ramp that the waves slide up. Once the water passes the convexity of the USCG reference vest it rolls down a short slope into the nose and mouth. For a given wave height and frequency sensors typically on mannequins detect the beginning of water splashing against the airway.

The present invention discloses two different butt structures depending upon the type of jacket. For the non-reversible vest the but angles from the victim up and away. For the reversible PFD there is a V cut into the butt so that which ever side ends up being the top, one half of the jackets thickness remains angled against the oncoming waves where it serves to rebuff the waves. For the jacket used in

the open sea the butt can be widened to increase its height above the water's surface. This bell bottom shape serves two functions. It shifts the buoyant moment down and forward which complements the shift of the center of gravity up and back by positioning the ballast high and if possible to the rear if one exists i.e. in non-reversible jackets. The butt of the ventral arms is ideally covered by a course open weaving that serves two purposes. It breaks up the water and allows rapid drainage by replacing the grommets occasionally found in that position.

The reverse cant at the end of the jacket redirects the wave away from the oral-nasal area. Once wave height and or frequency cause waves to crest over the height of the butt it will roll along the superior face of the PFD towards the oral nasal area. At this juncture the jacket that is short but fat has a purported turning advantage but is more quickly over taken by the waves. That is the present invention jacket keeps a long ventral arm to establish a break water at some distance from the face.

Given the severity of the waves upon the victim bobbing at sea, the ventral arms can be partially cut below the chest strap. This creation of a hinge below the strap does two things. The flexibility about that joint assists the backward rescue of the victim complementing the bell bottom shape and the posterior ballast moment to increase the torque applied to the vertical victim. The torque generated around the axis through the waist is critical in eliminating the danger zone from the design, thereby creating prevention as the primary response by the PFD to hypothermia leading to loss of consciousness.

Eventually, even with a ventral arm the entire length of the torso, mounting seas will eventually crest the butt

then roll down the face of the PFD towards the victims nose and mouth. At a distance of a few inches from the victim's mouth one or more ridges along the surface of the PFD redirects the water off to the side away from the oral nasal area. The second ridge catches the first water that rides over the first ridge and redirects that water away. With the present invention, the wave must be big enough to first rise above the but of PFD flexed up about the chest strap, then must be big enough that it doesn't break within the distance from the butt to the face where it would be redirected away. The wave must be big enough to crest all the way over the jacket and directly down onto the face before the victim would suffer from passive intrusion of breaking seas in their airway way.

Applied specifically to Inflatable Type I and SOLAS Type I, a fabric collar carrying the oral-nasal splash guards also serves to hold a fabric lock at the top of the ventral arms beneath the chin. As the bladder is inflated it jams the fabric lock together. The fabric lock is critical to the performance of the inflatable PFD because on unexpected water entry particularly when unconscious, the ballast of the head drives the neck like a wedge between the ventral arms. In this position the inflatable fails to provide airway protection. Uniquely the fabric lock is compatible with the automatic detonator in the sense that if the individual is knocked unconscious before entry after a few seconds the jacket will inflate automatically after exposure to water. The pressure of the inflating chambers first opposes than compresses the lock keeping the head from falling from position.

Figures 66 through 81 illustrate the garment integrated multi-chambered personal flotation device, life jacket,

and/or the like, embodiments of the present invention. The individual in figure 66 is wearing body armor as the garment to which the PFD is attached. The forward bladder 1d is referred to the inferior bladder due to its position when floating vertical in the water column. As seen in figure 66 the superior bladder 2d can be detached from the inferior bladder at the top creating a moderate amount of displacement in a relatively low profile for the victim carrying 19 lbs. of tactical plate. The offsetting buoyant displacement requires a mobile eccentric buoyant moment to initiate corrective turning. The use of buoyant chamber is so strong that it can trap the mobile element against the lower torso or legs depending on the resting location of the buoyant chambers against the flaccid victim. Consequently reliable turning requires mobile buoyant elements in both the inferior position 3d and superior position 4d. The inferior margin of bladder 1d can be attached by a reversible means such as zipper 5d to 14d to the bladder containment cover. For increasing amounts of buoyancy the attached edge of bladder 1d can be moved away from bladder 2d by affixing the bladder at zipper 6d or 7d depending on the amount of displacement required by the individual and their attached gear. Mobile buoyant bladder 3d can be attached to large volume displacement bladder 1d by way of flexible tube 8d, which can conduct inflation gas through quick release one way check valve 9d. The fixed bladders 1d and 2d and the mobile bladders 3d and 4d can be inflated by compressed gas cylinder 10d through detonator 11d which can be activated by water through optional device 12d or manually through pull cord means 13d. The inferior cover 14d and superior cover 15d can contain the stowed abdominal bladders in their deflated state.

The water-activated collar 16d can be released from cover 21d by automatic detonation in the event of unexpected water entry or manually via ripcord 21d. Illumination and signaling device 22d can be powered by combined battery ballast means located on the posterior centerline. The quick release means for the inflatable collar can be integrated into the quick release system 23d of the two part armored vest garment 27d. Heavy duty D-ring harness means 24d allows rescue and recovery of the armored water accident victim 28d. A water activated detonator can release and inflate a raft 25d stowed in the back of the garment. An unpredictable wide variety of armaments can be located about the chest and waist further increasing the need for the disclosed high torque corrective turning created by the unique combination of fixed and mobile buoyant moments.

Figure 67 is a close up of the side of the abdominal bladder system comprised of superior bladder 31d folded tight upon itself by connecting the lateral edge 35d to the back wall 14d, reducing available volume for inflation/displacement. Inferior bladder 31d can also be held in close quarter by attaching lateral edge 36d also to the back wall. The excess fabric noted at 33d and 34d accounts for the relative reduced volume of the mounting configuration depicted (Figure 67). Oral inflation tube 38d can connect oral/overpressure valve 37d to bladder 31d. Bladders 31d can be continuous so that use of pressurized gas or oral inflation fills all chambers assembled. In the low volume configuration (Figure 67) the inferior chamber 30d may not have the length of arm needed to trap mobile buoyant element 3d and so sufficient initiation force can be generated by a single mobile element in this configuration.

In the reduced volume state (Figure 67) any excess gas on inflation can be discharged through overpressure valve 37d.

Figure 68 depicts the outcome of attaching the lateral edges of bladders 40d and 41d along the midline at 42d. This results in a moderate amount of excess fabric 43d reflecting the reduced volume achieved by joining the bladders in this fashion.

In figure 69 the bladders are held to the garment wall at superior bladder junction 5d and inferior bladder attachment 54d. The lateral edge 2d of superior bladder 51d and the lateral edge 53d of inferior bladder 50d can flare apart allowing increased filling/displacement. The minimal reduction in full deployment can be achieved by closely attached medial edges at 5d and 54d as reflected in minimal compression along the midline 55d.

Figure 70 depicts both bladders unconstrained thereby producing the maximum displacement possible for their size. Inferior bladder 60d can float above formerly superior bladder 61d. The bladders can be joined at the middle 62d with the lateral edge 63d of the inferior bladder 60d free. The superior bladder 61d can attach both bladders to the garment wall at 64d.

Figure 71 shows a quick release variable volume bladder system 75d stowed behind the Kevlar ballistics protection 77d, which can include a deflated inferior bladder 70d and deflated superior bladder 71d. The bladder container can be released when pressure is applied by detonation of cylinder 10d preferably by pulling lanyard 13d which activates the detonator. The expanding bladders can separate closure means 72d. Compressed gas can inflate fixed bladders 70d, 71d and mobile bladders 73d and 74d. In addition to the Kevlar fabric armor, garment 27d can also contain thick rigid armor

76d of considerable mass. Inferior quick release loops can hold the bladder to the garment preferably by ripcord 83d. The superior quick release means 79d can be secured preferably by ripcord 82d. When the wearer pulls on loop 80d, rip cords 81d release the shoulder and sides freeing the front and back panels to fall away. Simultaneously rip cords 82d and 83d can release the abdominal bladder to become an autonomous PFD.

Figure 72 Illustrates a contained variable volume bladder system that can be attached or removed from the garment 27d as indicated. In a desert operation a PFD would be needless. The safety of the same vest could be enhanced during a marine operation by the connection of complementary superior attachments means 90d and 91d and inferior attachments means 92d and 93d such as a zippers, snaps, hook and loop fasteners(i.e. VELCRO), buttons, and other conventional attachment mechanisms and assemblies.

Figure 73 demonstrates garment 27d with permanently attached variable volume abdominal bladder system 75d sewn along the superior edge at 100d and along the inferior edge 101d. Other attachment mechanisms and assemblies can also be used and are considered within the scope of the invention. Such a vest might be preferred by a maritime organization such as the USCG.

Figure 74 demonstrates a self-closing self-locking inflatable collar. The acute angle at 110d can convert the two-dimensional flat fabric into a marked flexure state when inflated into three dimensions. A similar flexure at 111d brings the opposite around so that the arms overlap, filling the void under the flaccid victim's chin. This single wall construction can benefit from using fabric coated on both sides preferably by film responsive to welding. The exterior

coating allows direct attachment of flap 114d to the topside of the collar 113d allowing the complementary fabric lock system 115d and 116d to be secured along the entire perimeter. The efficacy of the cross arm flexure created by angle 110d relocates oral inflator and over pressure valve 112d towards the victims mouth to allow adjustments in pressure/flexion to further accommodate a wide range of neck diameters.

Figure 75 illustrates the inferior side of a quick release collar that ties into the quick release system for jettisoning the front and back panels of the armored vest. A flap of fabric 120d, preferably weldable, can be attached, such as by welding to collar 113, though such attachment method is not considered limiting. Retaining cover 121d can be attached to 120d, which is shown in the open position because collar 113d is fully inflated. Attachment means 123d secures ripcords 124d to the back of the vest. The anterior ends are secured at 125d on the front of the vest. In the event that the vest is released, the secured state at 125d is disconnected. As the rear panel of the vest falls away, the cord 124d can be removed from securing means 122d freeing the collar to remain around the victim's neck as the panel drops away.

Figure 76 is a posterior lateral view of the garment 27d with cover flap 130d stowing raft 25d that is inflating upon water activated release of gas from cylinder 133d peeling apart pressure sensitive securing means 131d. The initial detonation can release fabric lock 132d on cover flap 130d from the back of the garment 27d allowing the release of the expanding raft.

In figure 77 a high strength nylon locking means 140d can secure the zipper pull 143d to the garment through loop

141d. Alternatively, the pull could be attached to a loop created by excess zipper fabric 142d. The mechanism is very secure preventing the separation of zipper 144d even when under the types of forces generated by a high lift bladder buffeted in a sea state. The locking means 140d is preferably used to mount the bladder to the housing as well as to the garment itself.

Figure 78 adapts the functional advantage of two chambers to a single chamber PFD for a garment that opens along the midline. The midline opening forces the abdominal bladder to be split. The left bladder 150d is seen extending from garment. Pocket cover 153d is peeled back at 154d showing the midline compression 151d of the complementary fabric lock 152d. The medial position of the cover can be held in place by attachment means 155d. The lateral margins of the pocket can be permanently sewn 156d to create a funnel device that directs the abdominal chambers out toward their midline union 151d. CO2 cylinder 158d can be manually activated preferably by pulling ripcord 157d. The abdominal 150d and cervical 160d chambers can be connected by conduit 159d.

Figure 79 illustrates a triple layered dual chamber bladder that combines a low volume and pressure primarily oral inflated chamber and high-pressure gas inflated chamber. The construction preferably can include a middle layer 162d to be coated on both sides while the top layer 161d and bottom layer 163d can be coated on only the inner facing side. An over pressure relief valve 164d can be in line in the connecting conduit 165d between the high and low-pressure containers. Bilaterally abdominal bladders 166d can be connected by fabric lock 167d. While both chambers can be inflated orally, the large bore inflator 168d can go

to the smaller of the two, while the high-pressure chamber can have a small reserve oral inflator 169d. Both chambers can be protected from over inflation by the same over pressure relief valve 173d. CO2 cylinder 171d and detonator 170d can be connected to the larger chamber. The bladder can be held in place in the garment by fabric fasteners 172d. A weld line 14d can separate the two chambers. The collar can be enhanced by an overlapping mechanical component 176d preferably covered by complementary fabric lock 175d.

The compressed gas cylinder 180d seen in figure 80 can be located within the bladder. Its detonator can be radio frequency welded 189d to the inner bladder. A foam shelf 181d can protect the rear bladder wall from the cylinder. This foam can be housed 182d and secured to the bladder wall 183d. An opening 184d can be provided in the housing for inserting the foam. Incorporation of a desiccant reduces corrosion. The CO2 cylinder can be permanently attached at 186d to the detonator so that it will not become inoperable due to loosening. The superior bladder wall can also be protected from puncture by covering it with fabric 187d. The CO2 detonator can be actuated by squeezing or striking.

In figure 81 a very low profile bladder allows use with the waistband of shorts or pants. The bilateral abdominal bladders 193d and 194d compress and lock in the midline. The attenuated abdominal bladders communicate through conduit 190d to the attenuated cervical collar 192d.

Certain advantages and/or features of the garment integrated multi-chambered embodiments shown in Figures 66 through 81 include, but are not limited to:

(1) A bladder whose volume can be varied as needed to supply a range of displacements; (2) A variable volume bladder which can be permanently attached; (3) A variable

volume bladder whose attachment can be varied prior to use; (4) A variable volume bladder whose attachment can be varied while in use; (5) A variable volume bladder whose attachment can be quickly released while in use; (6) A bladder whose volume can be varied as needed to supply a range of displacements; (7) A variable volume bladder which can be permanently attached to the underlying garment; (8) A variable volume bladder whose attachment to the underlying garment can be varied prior to use; (9) A variable volume bladder whose attachment to the underlying garment can be varied while in use; (10) A variable volume bladder whose attachment to the underlying garment can be quickly released while in use; (11) Variable volume abdominal bladder, which is configured to provide airway protection independently once, separated; (12) A variable volume bladder contained within a pneumatically released stowage container capable of being reversibly affixed to the garment; (13) One or more buoyant bladders that have attachment means on both sides of bladder; (14) Bladder containment means having two or more complementary attachment means for securing said bladder in more than one position; (15) Multiple attachment points allowing the displacement volume of the bladder(s) to be decreased or increased according to need; (16) Distinct mobile eccentric buoyant bladder means; (17) Distinct mobile eccentric buoyant bladder attached to the inferior aspect of the primary displacement means; (18) Distinct mobile eccentric buoyant bladder attached to the superior aspect of the primary displacement means; (19) Distinct mobile eccentric buoyant bladders attached to the inferior and superior aspects of the primary displacement means; (20) Mobile eccentric buoyant bladders connected pneumatically to the main displacement bladder; (21) Mobile eccentric buoyant

bladders connected pneumatically with check valve between the main displacement bladder; (22) Mobile eccentric buoyant bladders connected pneumatically with quick release check valve between the main displacement bladder; (23) Mobile eccentric bladder connected to garment; (24) Mobile eccentric bladder connected to bladder; (25) Mobile eccentric bladder connected to strain relief means; (26) High volume bladder connected to garment by functional arm so that it serves as mobile buoyant moment; (27) Self closing pneumatic inflatable collar; (28) Self locking pneumatic inflatable collar; (29) Quick release collar allowing separation from garment; (30) Sewable plastic piping and tightly conforming stiff plastic cord creating shear to prevent quick release means unintentionally activating; (31) Collar constructed from fabric coated on both sides allowing welding flanges to the surface for attaching fabric lock and attaching to container and or garment; (32) CO_2 cylinder attached on posterior center as fixed midline ballast; (33) Mounting means for attaching ballast power supply midline; (34) Garment integrated multi-chambered PFD system in which one of the chambers is a raft; (35) Garment integrated multi-chambered PFD system in which one of the chambers is a raft inflated automatically upon sudden water entry; (36) Locking means for securing zipper pull to prevent separation of mounting zipper; (37) Locking means for securing zipper pull to prevent separation of mounting zipper using fabric loop attached to garment; (38) Locking means for securing zipper pull to prevent separation of mounting zipper using fabric loop constructed from excess zipper material; (39) Single chamber functioning as three chambers; (40) Bilateral abdominal chambers directed by fabric funnel to directional inflated towards midline; (41)

Bilateral abdominal chambers that compress along the midline converting the two chambers into a functional single chamber; (42) Bilateral abdominal chambers stowed beneath pneumatically released covers; (43) Bilateral abdominal chambers in connection with self closing self locking pneumatic collar; (44) Triple layered chamber constructing two functional chambers allowing for a combination of low pressure and high-pressure chambers to increase net displacement above 16-gram standard cylinders; (45) Two functional chambers that share a wall in common connected by one way check valve; (46) Diagonal front entry allowing mechanical obstruction of neck opening such that downward pressure compresses fabric valve preventing shifts of the heads ballast; (47) High-pressure chamber leading to low pressure chamber where over pressure relief protection of both chambers is accomplished with a single pressure relief valve; (48) Single use PFD chamber in which the detonator and cylinder are permanently attached and sealed within bladder increased chances that all parts will be tight and present upon use; (49) PFD chamber containing desiccant; (50) PFD chamber with internal fabric means protecting both bladder walls; (51) Detonator welded to wall for support and localization; (52) Detonator activated by impact or compression; (53) Extremely low profile PFD bladder for cosmetic inclusion in routine clothing; and (54) Multiple self-closing and self-locking chambers optimize turning and surface position.

Parts List (Figures 66 through 81)

Manual override CO2 detonation rip cord of water activated collar inflation system

1d Inflated inferior chamber means detached at along upper edge;

2d Inflated superior chamber means detached at along upper edge

3d Inferior mobile eccentric buoyant means

4d Superior mobile eccentric buoyant means

5d Complementary bladder container mounted attachment means configuring bladder for smallest volume

6d Complementary bladder container mounted attachment for configuring bladder for medium volume

7d Complementary bladder container mounted attachment means for configuring bladder for largest volume

8d Pliable connection means for inflation serving as flexible arm for mobile eccentric buoyant means

9d Check valve combined with quick release disconnect means

10d Compressed gas cylinder

11d Compressed gas cylinder detonation means

12d Optional water activated compressed gas cylinder detonation means

13d Ripcord for manual activation of compressed gas detonation means

14d Variable bladder mounting means

15d Superior pneumatically released bladder cover flap in the open position

16d Water activated compressed gas inflated self locking quick release collar

17d Welded tab allowing secure lateral attachment of pneumatically located and compressed interlocking fabric means

18d Left complementary automatic fabric lock

19d Right overlapping inflated arm means supplying cervical positioning means and mechanical lock means covered with complementary automatic fabric lock means

20d Ripcord for manual activation override of water activated detonation means for actuating inflation means

21d Pneumatically released inflatable collar containing flap in the open position

22d Remote illumination or signaling strobe connected to posterior fixed midline ballasting power supply

23d Quick release means for collar bladder integrated into quick release means for vest

24d Integrated harness and over sized lifting D-ring means for aerial extraction

25d Water or manually activated pneumatically released raft means integrated into garment

26d Variably sized and eccentrically located ballasting armament pockets

27d Garment

28d Sudden water entry victim

30d Inferior, structurally or functionally distinct or structurally and functionally continuous bladder configured to provide lowest profile lowest, volume lift bladder.

31d Superior, structurally or functionally distinct or structurally and functionally continuous bladder configured to provide lowest profile lowest, volume lift bladder.

32d Excess bladder inferior and superior fabric equivalent to the amount the inferior and superior bladders are reduced in volume by conjoint compression

33d Excess fabric equivalent to the amount the superior bladder is reduced in volume by close attachment of both inner and outer edges of bladder in closest configuration

34d Excess fabric equivalent to the amount the inferior bladder is reduced in volume by close attachment of both inner and outer edges of bladder in closest configuration

35d Outer edge of the superior bladder attached to bladder mounting means affixed to the garment

36d Outer edge of the inferior bladder attached to bladder mounting means admixed to the garment

37d Over pressure oral inflator valve

38d Oral inflation tube

40d Inferior bladder compressed along midline

41d Superior bladder compressed along midline

42d Outer edges of inferior and superior bladders joined to limit volume of buoyancy system

43d Excess fabric from inferior and superior bladder equivalent to the amount the inferior and superior bladders are reduced in volume by constrained conjoint compression

50d Inferior bladder partially constrained from maximum displacement by close attachment at base

51d Superior bladder partially constrained from maximum displacement by close attachment at base

52d Detached inner edge of superior bladder

53d Detached inner edge of inferior bladder

54d Closely contiguous base attachment of inferior bladder to base of superior bladder limiting inflation / displacement of bladder

55d Minimal midline compression of contiguous bladders

60d Inferior bladder fully inflated providing maximum displacement

61d Superior bladder fully inflated providing maximum displacement

63d Attached inner edges of inferior and superior bladders

64d Single attachment of superior bladder to mounting container means

70d Deflated and stowed inferior bladder

71d Deflated and stowed superior bladder

72d Pressure actuated bladder container release means

73d Deflate inferior mobile eccentric bladders means

74d Deflate superior mobile eccentric bladders means

75d Bladder stowed in protected position behind ballistics components of garment

76d Rigid armor protecting from rifle shot

77d Kevlar panel protecting from pistol shot

78d Inferior quick release means for mounting stowed variable volume and mobile eccentric buoyant bladders

79d Superior bladder quick release means for mounting stowed variable volume and mobile eccentric buoyant bladders to garment

80d Quick release pull ring

81d Quick release wires to ballistic vest shoulder release means

82d Superior wire cable to quick release means for securing buoyant bladder to garment

83d Inferior wire cable to quick release means for securing buoyant bladder to garment

90d Superior garment attachment means integrated during construction allowing option of abdominal PFD

91d Superior PFD attachment means integrated during construction of variable bladder mounting means allowing option of abdominal PFD

92d Inferior garment attachment means integrated during construction allowing option of abdominal PFD

93d Inferior PFD attachment means integrated during construction of variable bladder mounting means allowing option of abdominal PFD

100d Superior permanent attachment means securing variable volume abdominal bladder to garment

101d Inferior perimeter of permanent attachment means securing variable volume abdominal bladder to garment

110d Acute angle on left side of neck opening sets degree of retraction of collar arm across throat of wearer

111d Acute angle on right side of neck opening sets degree of retraction of collar arm across throat of wearer

112d Angle of oral inflator such that conversion from 2 dimension into 3 dimension reorients oral inflator towards victim's mouth

113d Fabric coated with weldable film on both sides allows attachment of sewing tabs directly to collar

114d Sewing tab for lateral edge of fabric lock welded to surface of inflatable collar

115d Complementary hook fabric relocated and compressed upon inflation

116d Complementary loop fabric relocated and compressed upon inflation

120d Flange welded to inflatable PFD collar for securing to garment

121d Inflatable collar stowage cover

122d Collar's complementary quick release means

123d Posterior garment attachment means securing quick release cable to ballasted vest

124d Quick release cable

125d Anterior garment attachment locking means interfacing with vest quick release system

130d Cover flap containing raft

131d Pneumatically driven release means

132d Locking means reducing accidental deployment

133d Compressed gas cylinder water activated

140d Field locking means

141d Loop sewn to garment

142d Loop sewn from extra cloth at end of zipper

143d Zipper pull

144d Zipper locked in closed position

150d Left abdominal bladder

151d Midline compression of right and left abdominal bladders

152d Complementary pneumatically compressed fabric lock

153d Pocket cover flap

154d Portion of flap peeled back by expanded abdominal bladder

155d Complementary fabric lock formerly sealing pocket flap closed

156d Permanent stitching securing back half of pocket creating a funnel directing the expansion of the abdominal bladder toward the midline to compress the fabric lock

157d Rip cord

158d Compressed gas cylinder

159d conduit for transferring gas from cylinder to other chambers in low volume PFD

160d Compressed gas inflated self-closing and self-locking inflatable collar

161d Top layer coated on inferior or inner facing side

162d Middle layer, coated with weldable plastic on both superior and inferior sides

163d Bottom Layer coated on superior or inner facing side

164d Over pressure relief valve between top bladder and bottom bladder

165d Conduit connecting high pressure and low pressure chambers

166d Bilateral abdominal bladder means

167d Complementary fabric lock elements such as hook and loop

168d Large Bore inflation tube with over pressure oral inflation valve

169d Small bore emergency back up oral inflator

170d External detonator either manual or water activated

171d Cylinder selected to either inflate only high pressure chamber or high and low pressure

172d Bladder half of fabric lock for accurately securing bladder displacement means from migrating from operational position within garment upon impact

173d Combined oral inflation valve and over pressure relief valve for both the high and low pressure chambers

174d Weld line separating high and low pressure bladders

175d Overlapping Midline Pneumatic Fabric Lock

176d Diagonal mechanical jam lock

180d CO2 Cylinder Retaining Sleeve

181d Compressible foam shelf elevates the cylinder and handle from the posterior bladder wall

182d Foam shelf housing

183d Foam shelf housing perimeter attachment means

184d Opening in foam shelf housing for inserting foam shelf and desiccant means

185d Desiccant mean

186d CO2 cylinder permanently affixed to detonator means

187d Fabric protector enveloping sharp detonator surfaces and edges

188d CO2 detonator handle actuated through bladder wall

189d RF Welded mount for detonator

190d Vertical conduit for expanding gas between abdominal and cervical displacement means

191d Circumferential waist conduit for expanding gas connecting bilateral abdominal bladders

192d Reduced size cervical collar

193d Reduced left abdominal bladder

194d Reduced right abdominal bladder

195d Water activated and manual activated CO_2 detonator and cylinder assembly

The instant invention has been shown and described herein in what is considered to be the most practical and preferred embodiment. It is recognized, however, that departures may be made therefrom within the scope of the invention and that obvious modifications will occur to a person skilled in the art.